

Using Women's Stories to Share Alternative Mathematical Experiences in a First Year Seminar

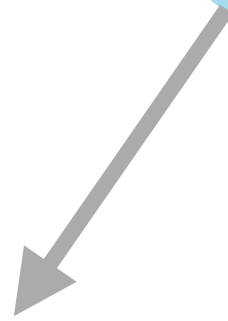
Sarah Mayes-Tang, University of Toronto

BIRS, Impact of Women Mathematicians on Research and Education in Math

March 2018



Images of
mathematicians



What are they?

Why do they
matter?

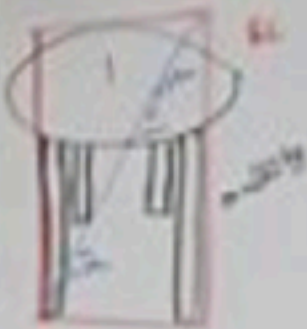


Diagram of a pulley system with a mass and a string. The mass is labeled m and the string is labeled L . The angle between the string and the vertical is θ . The force exerted by the string is F .


$$F = (L \sin \theta) (mg) \left[\frac{\sin \theta}{\cos \theta} \right]$$
$$= mg \sin^2 \theta$$
$$= mg \cos^2 \theta$$


Diagram of a right-angled triangle with a hypotenuse and a vertical side. The hypotenuse is labeled L and the vertical side is labeled $L \cos \theta$. The angle between the hypotenuse and the horizontal is θ . The force exerted by the hypotenuse is F .

$$|F| = |F|$$
$$(F \cos \theta) = mg \cos \theta$$
$$F = mg \frac{\cos \theta}{\cos \theta}$$


3

$$\theta = \pi \Delta$$

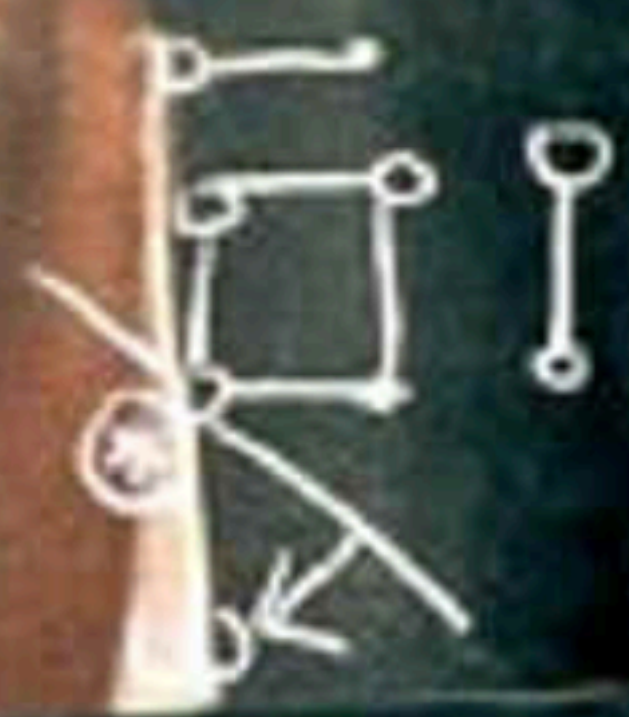
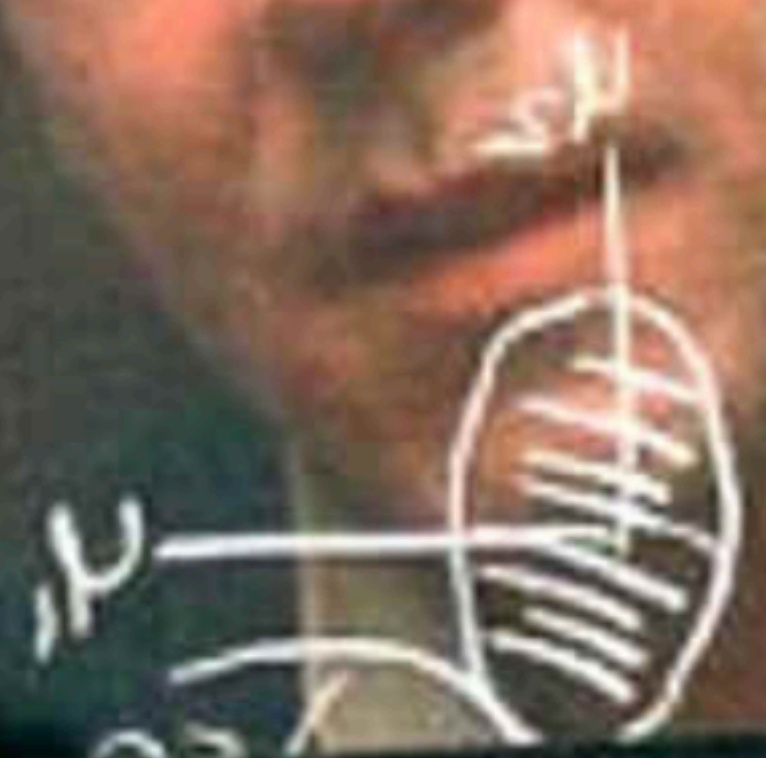
$$0 = \theta$$

$$0 \leq \pi \leq 1$$

$$(2\pi - \epsilon) \sum =$$

$$(\omega, \theta, \lambda) \neq +$$

$$f \in \mathbb{R}^d$$



Problem

Show that $\int_{-\infty}^{\infty} e^{-x^2/2\sigma^2} dx = \sqrt{2\pi}\sigma$

Hint: First show that

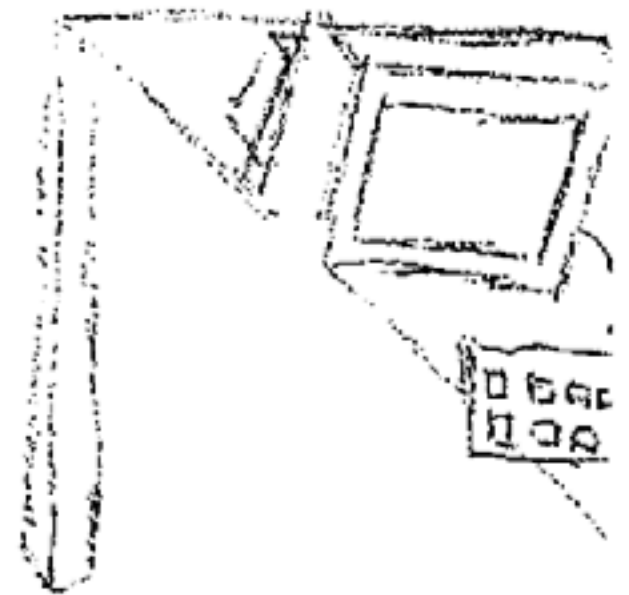
$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} e^{-(x^2+y^2)/2\sigma^2} dx dy = 2\pi\sigma^2$$



$$1 \frac{1}{2} \frac{1}{3} \frac{1}{4} \frac{1}{8} \frac{1}{16} \frac{1}{32}$$

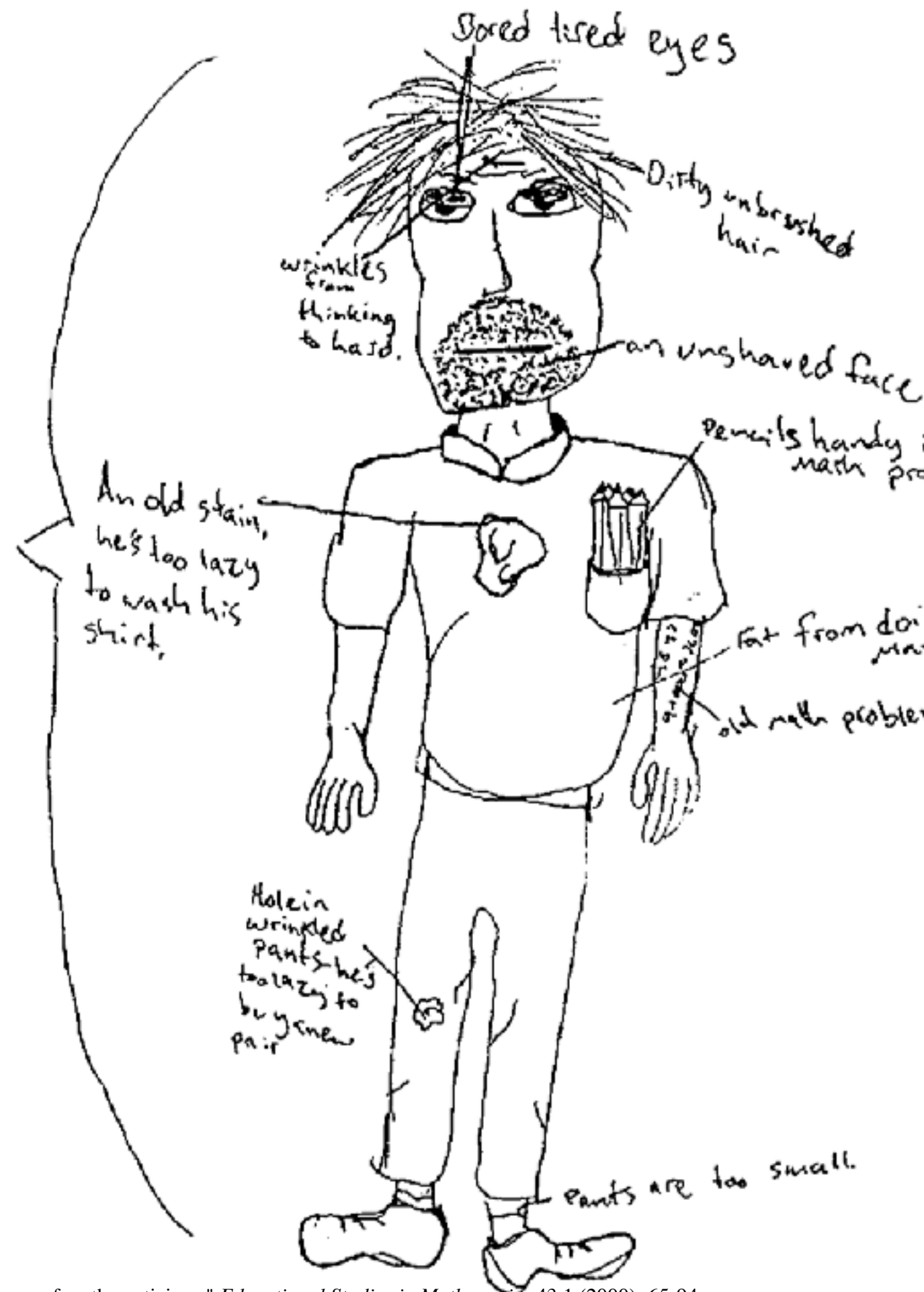
mmm
 $2 \times 2 \div (4 \times 4)$

$$E=mc^2$$

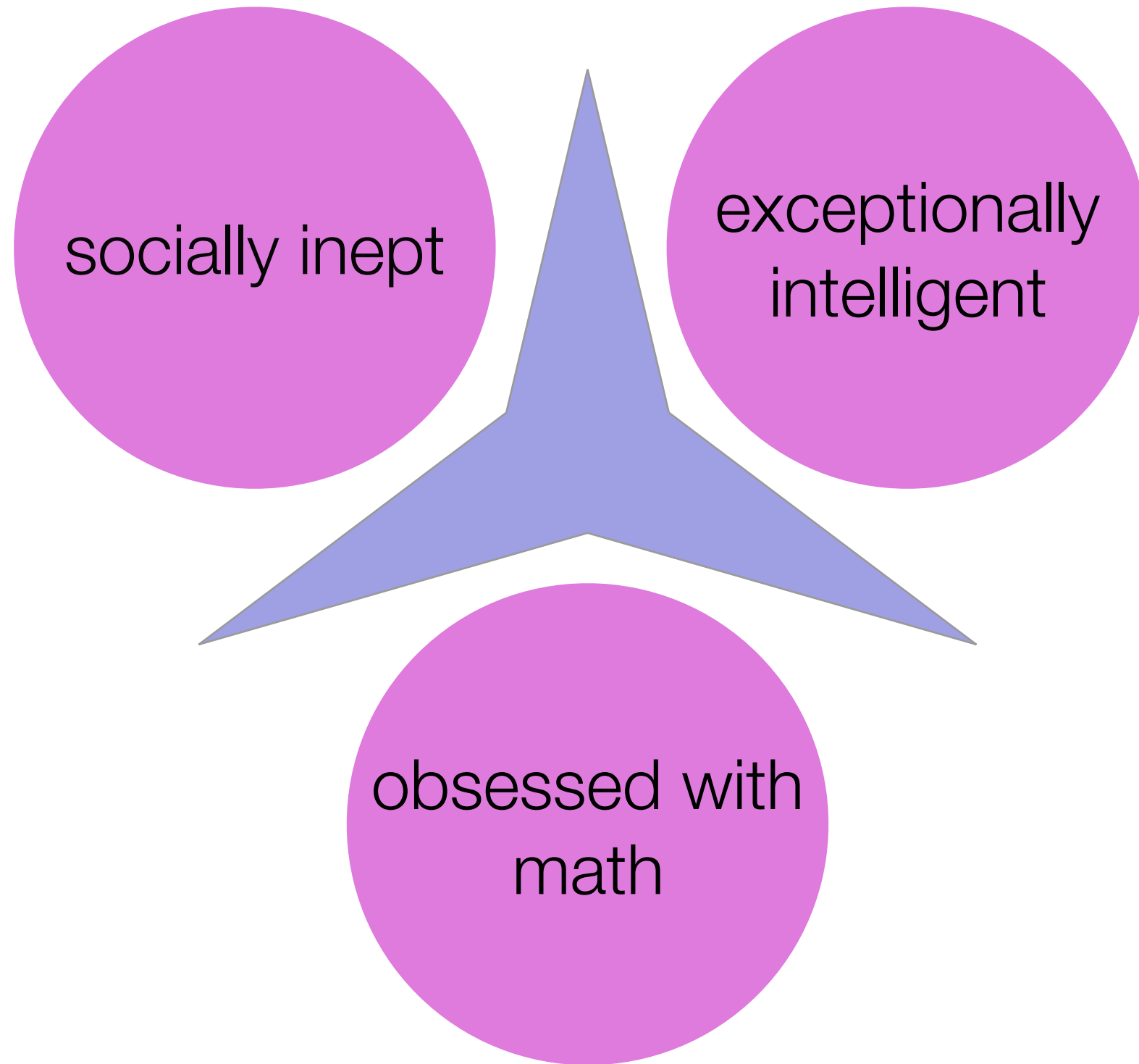


Draw a Mathematician: Themes

- Mathematics as coercion
- Foolish mathematician
- Overwrought mathematician
- Mathematician who can't teach
- Disparagement of mathematicians
- Einstein effect
- Mathematician with special powers



Undergraduate women's images





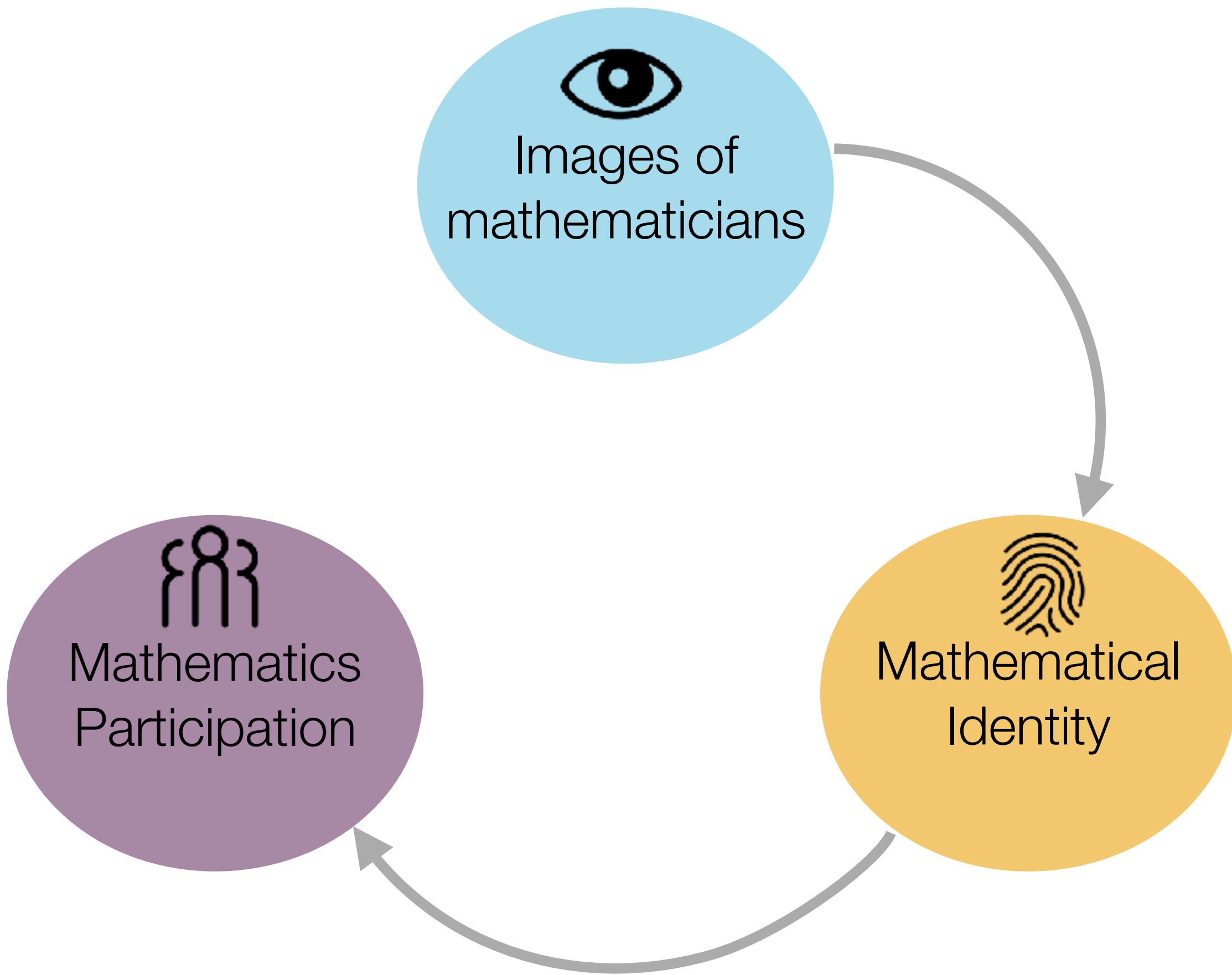
Images of
mathematicians



Mathematical
Identity

“The image of mathematicians... causes dissonance with the traditional *female gender identity*. Therefore, whether consciously done so or not, women who become mathematicians must either choose not to accept the stereotypical traits of mathematicians or choose not to identify with traits of their traditional *female gender identity*..”


- Katrina Piatek-Jimenez



Images of
mathematicians

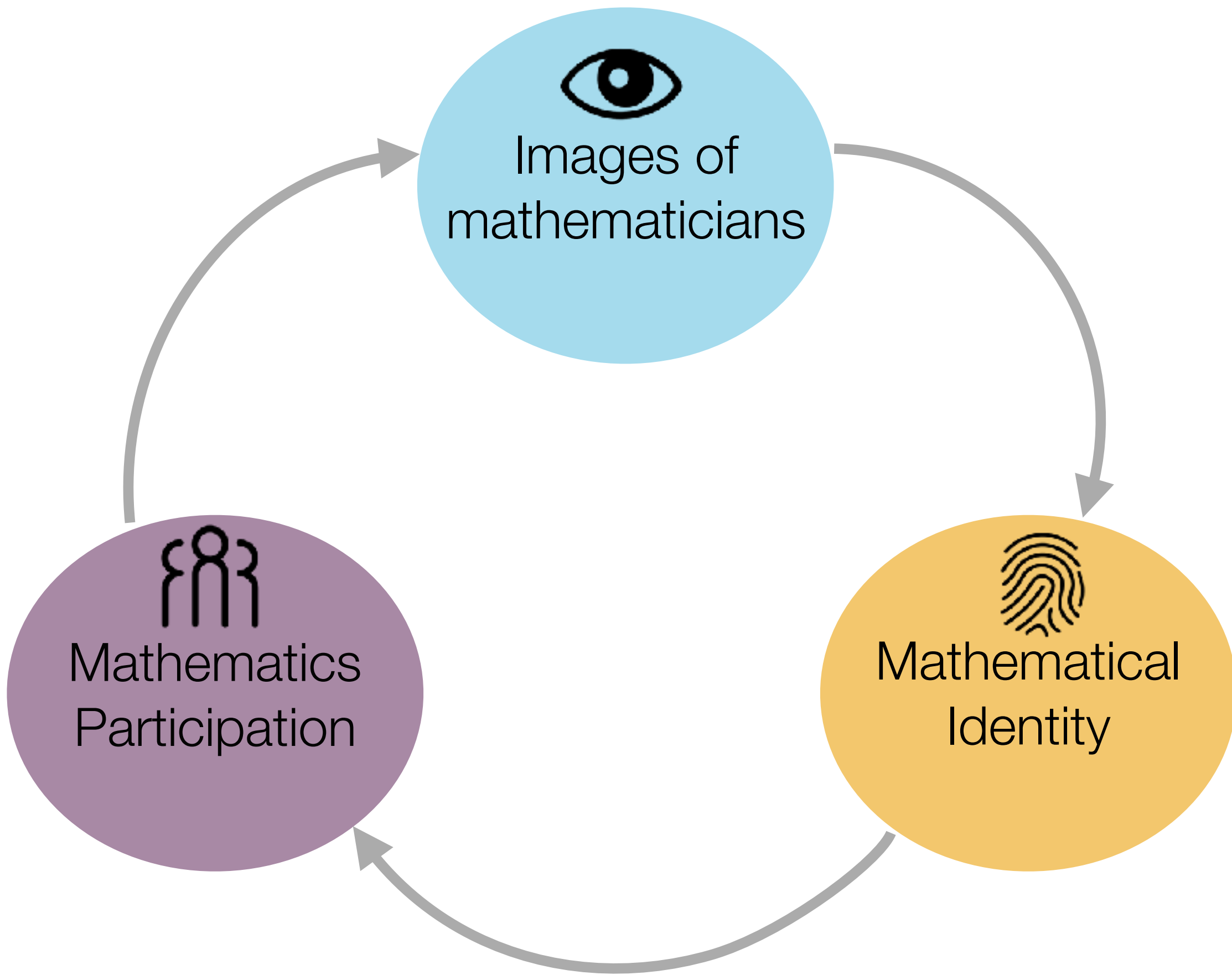
Mathematics
Participation

Mathematical
Identity



Dad, can you help me with my reading?

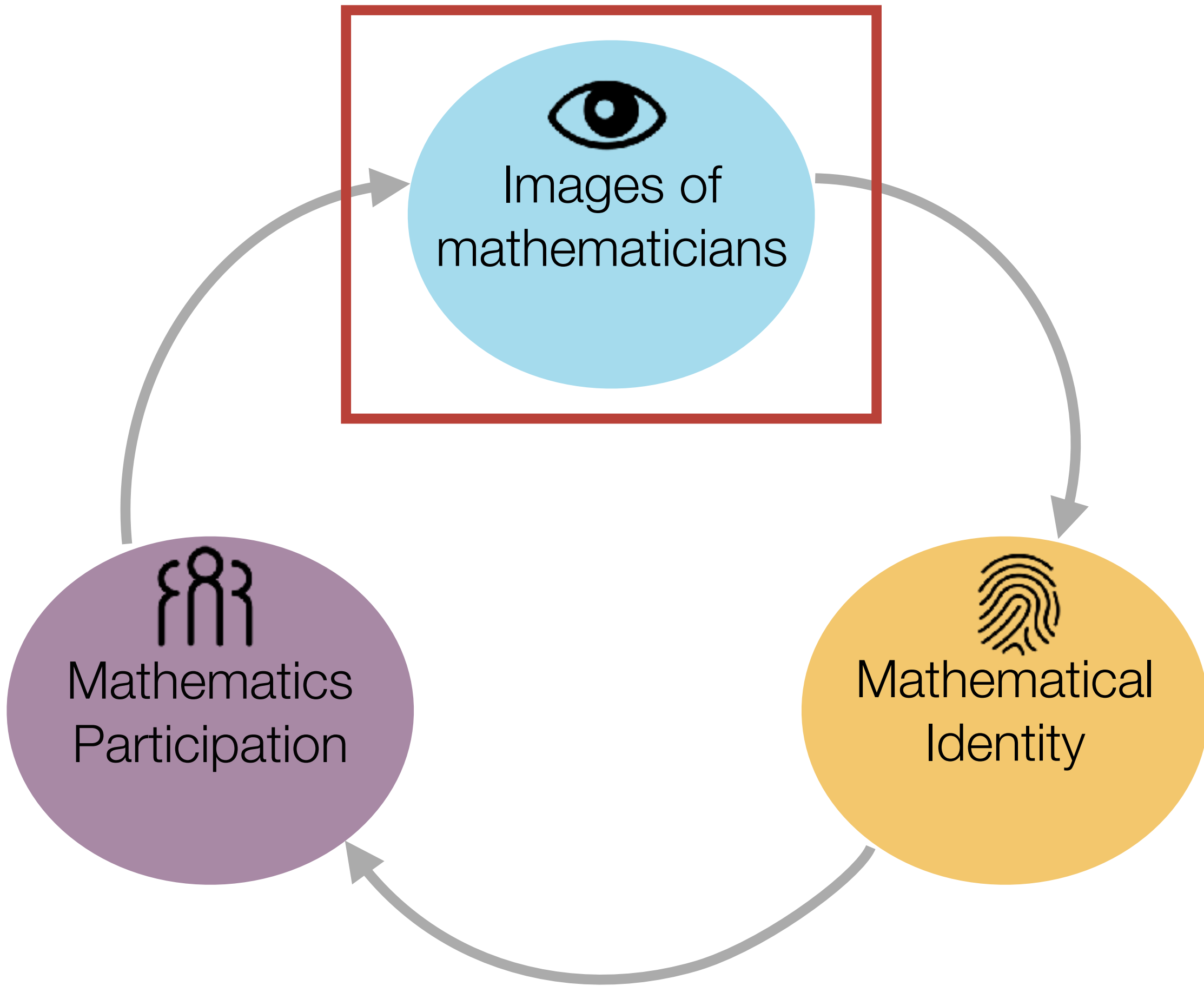
Sorry Ella, I'm just not a reading person



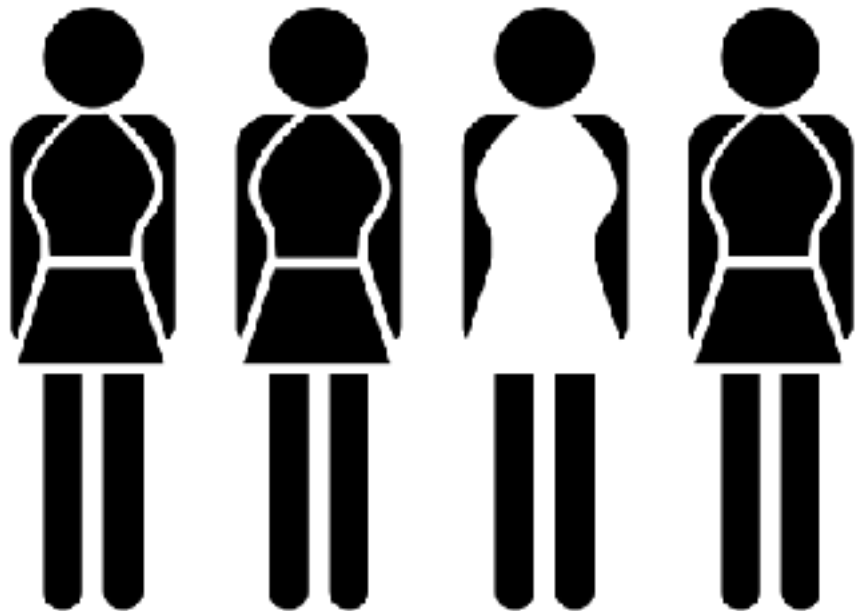
Images of
mathematicians

Mathematics
Participation

Mathematical
Identity



Mathematicians who counter stereotypes....



may be seen only as
exceptions to the rule



may be viewed as
'unbelievable' or 'too good'

Bamberger, Yael M. "Encouraging girls into science and technology with feminine role model: Does this work?." *Journal of Science Education and Technology* 23.4 (2014): 549-561.

Betz, Diana E., and Denise Sekaquaptewa. "My fair physicist? Feminine math and science role models demotivate young girls." *Social psychological and personality science* 3.6 (2012): 738-746.

Seminar: Context



20 1st and 2nd year students



Required liberal arts distribution requirement



Purpose: “think like a mathematician”

What is Math?

Math Content

Number Theory

Topology

Group Theory

Math & Humans

Knowledge in Math

People in Math

Mathematical Community

“Storytelling is the most powerful way to put ideas into the world.”

–Robert McKee

Joan Birman, 1927-

- Share a **variety of stories**, of both traditional and non-traditional paths
 - *Women in Mathematics: The Addition of Difference*
 - Simons Foundation *Science Lives*
 - Fields Medal videos
- Topologist, braid and knot theory
- “the community has bought hook, line, and sinker this whole idea that if you are going to do research, you do it when you are young.... I don't think there is merit in it. I think doing math when you're enthusiastic, yes, that's what is important. Not your age.”



Mary Ellen Rudin, 1924-2013

- Tell **rich & complex stories**, of both professional and personal lives
- **Connect** to students' lives
- Topologist, known for constructing counterexamples
- “I have never minded doing mathematics lying on the sofa in the middle of the living room with the children climbing all over me”



Marian Pour-El, 1928-2009

- Address **internal and external influences**
- Discuss both **barriers and successes**
- Logician, computability
- “It was depressing.... I remember thinking after a while that I was not getting anything done. I was very, very despondent.”



Judith Roitman, 1945-

- **Women's stories** are unique
- Set Theorist and Topologist
- "... a very common written comment that a woman would get would be 'works very hard'...So It's like they were giving me credit for something I wasn't doing and taking away credit for my natural intelligence. That really got on my nerves."



Requires
intentionality

Variety of
experiences

Why
women?

Counter
mathematical
myths

Richness of
stories

Media &
Reading



Media &
Reading

Personal
Reflections



Media &
Reading

Personal
Reflections

Discussion &
Analysis

Media &
Reading

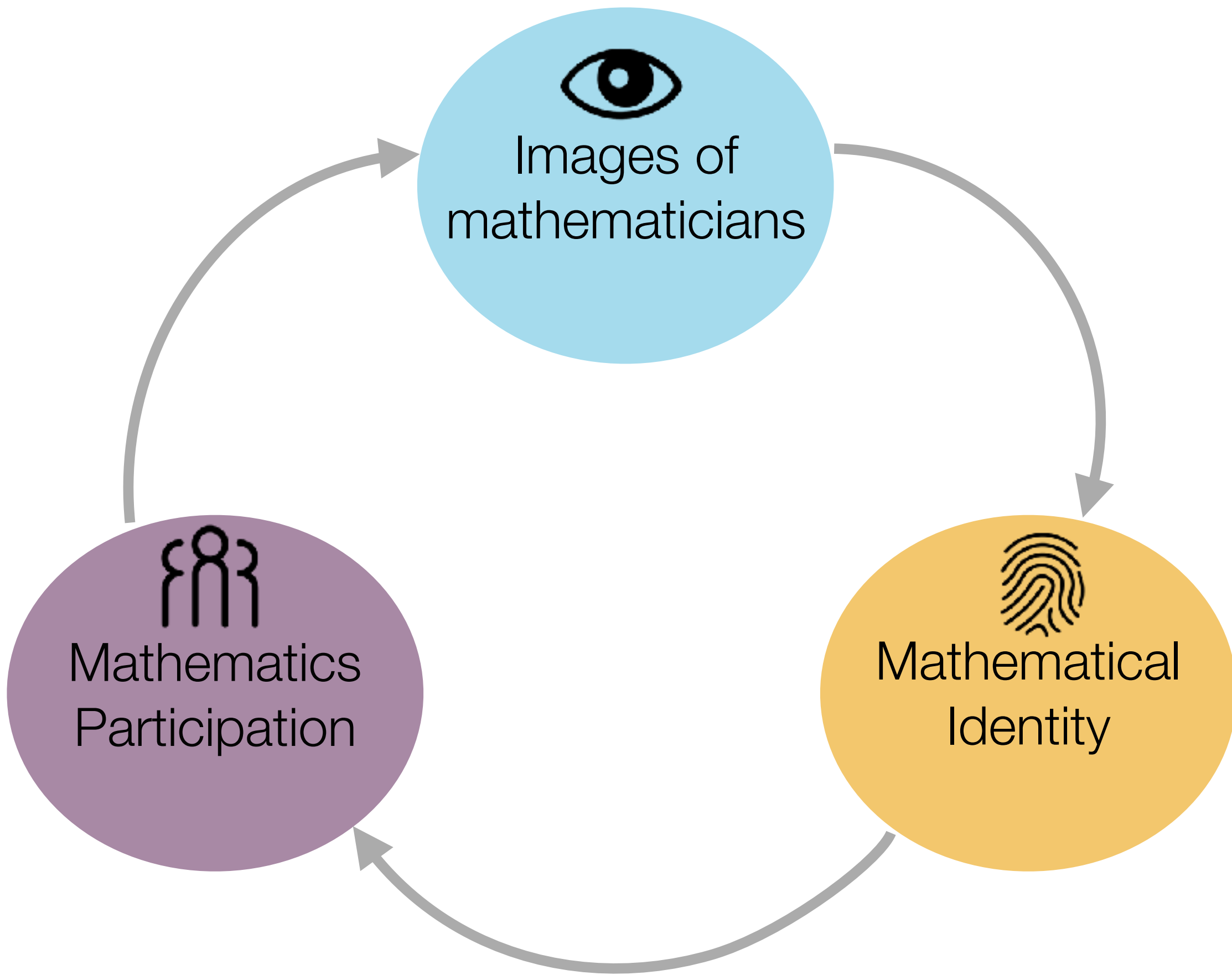
Personal
Reflections

Discussion &
Analysis

Synthesis:
Panel
Discussions

“Also, those stories gave me faith and courage that despite the challenges that these women faced, most of them were able to overcome them and become successful in the end. Hence, I know I would persevere as well, as long as I am passionate about Math and can find a strong group/association to be part of throughout the process. ”

–Student from *The Mathematical Experience*



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Mathematics
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Sources

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Berry, John, and Susan H. Picker. "Your pupils' images of mathematicians and mathematics." *Mathematics in school*. 29.2 (2000): 24-26.

Henrion, Claudia. *Women in mathematics: The addition of difference*. Indiana University Press, 1997.

Davis, Philip, Reuben Hersh, and Elena Anne Marchisotto. *The mathematical experience*. Springer Science & Business Media, 2011.

Piatek-Jimenez, Katrina. "Images of mathematicians: a new perspective on the shortage of women in mathematical careers." *ZDM* 40.4 (2008): 633-646.

Picker, Susan H., and John S. Berry. "Investigating pupils' images of mathematicians." *Educational Studies in Mathematics* 43.1 (2000): 65-94.

“The mathematical life of a mathematician is short. Work rarely improves after the age of 25 or 30. If little has been accomplished by then, little will ever be accomplished.”

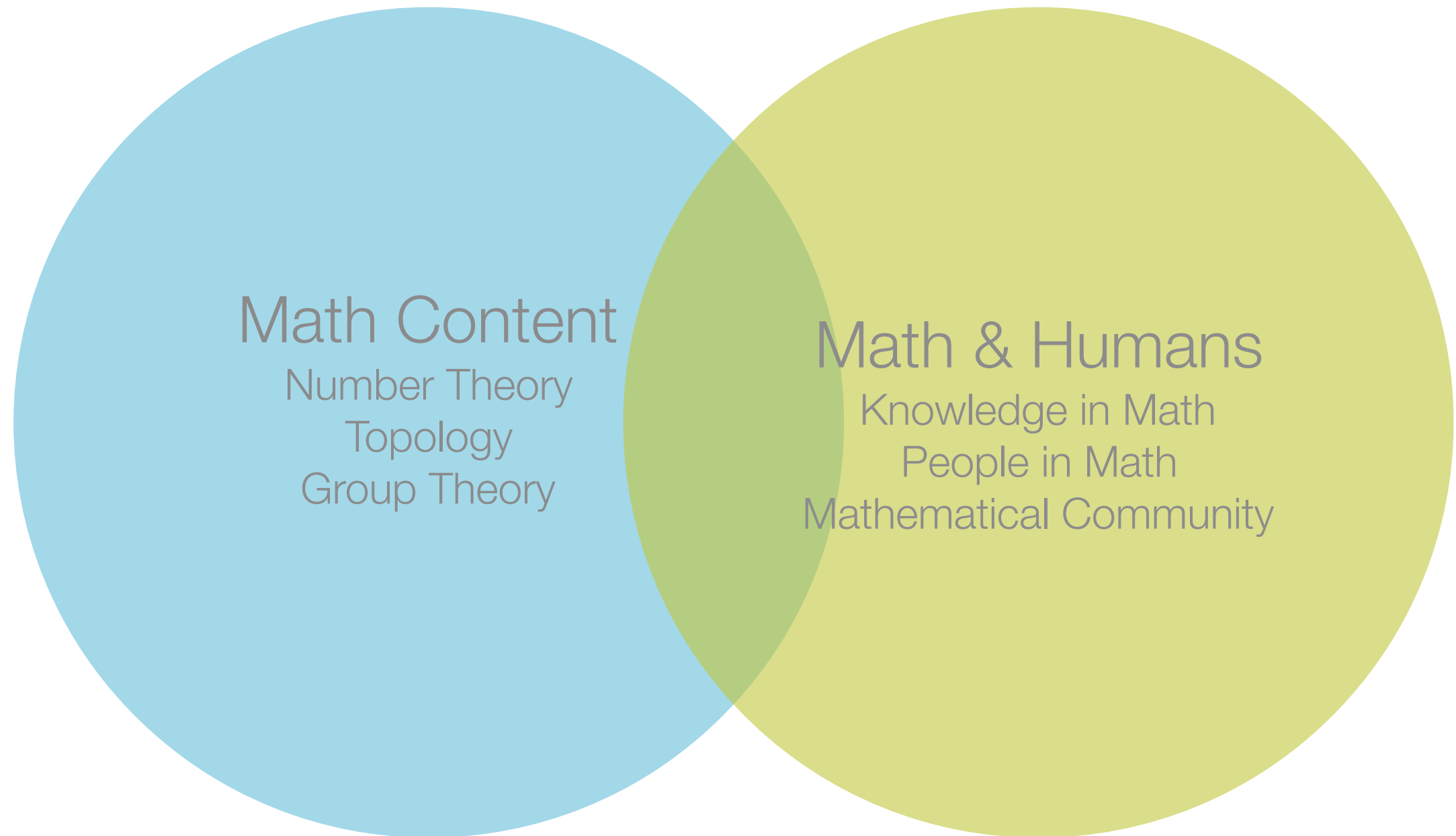
- Davis & Hersh, *The Mathematical Experience*

The Ideal Mathematician

(from *The Mathematical Experience*)

- “he”
- Intelligible only to a small group of specialists
- Incapable of showing or telling what he studies
- Finds it difficult to establish conversation with that large portion of humanity who doesn't understand his work

What is Math?



“modern” mathematics