Nature VS. Nurture in Math Ability
An International Perspective

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“I was never good in mathematics. I just want to pass this course. I have to. I am graduating this year!”

A quote from Agnes Arvai Wieschenberg’s *Overcoming conditioned helplessness in mathematics*, 1994

“I dropped out of math class by grade 10 because girls are not necessarily math-science oriented.”

My mother, translated from Cantonese, 1980’s and 1990’s

“I chose home economics over math because my math teachers can’t stand to have me for one more year.”

An American HS graduate in 1946
The beliefs about one’s abilities to learning mathematics

Schoenfeld (1989) and Tang (2007) both characterized how learners perceive math abilities: Nature VS. Nurture

**Nature.** The belief of the abilities in learning math comes from natural endowment and born talent.

**Nurture.** The belief that sufficient facilitation and the learner’s own effort can overcome difficulties in learning mathematics.

*Adopting a belief leads to a set of behaviors.*
How has the notion been studied?

**Interviews.** Schoenfeld (1989) asked how HS students the average time spent on one math problem. Answer: less than 2 minutes, and no one gave a response of over 5 minutes.

**Surveys.** Richardson and Suinn (1972) created the mathematics anxiety rating scale (MARS) using the Likert scale.

*Research related to math learning with nature/nurture has largely focused on the “I” and “He/she” perspectives.*
An integral view of the phenomenon

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Manifested behaviors

THEY perspective: No Child Left Behind -> Nurture

HE/SHE perspective:
Parent to Child, “All it took was one bad math teacher, and I was never good at it.” -> Nature

SAT Official Statement:
“There is no need to prep for the SAT because it measures aptitude instead of achievement.”
-> Nature [HE/SHE perspective]
An example from Seoul, Korea [“WE” perspective]

The South Korean government administers the College Scholastic Aptitude Test (Suneung in Korean) for high school seniors once a year. The Suneung score will determine which college they will attend, a result that some students and families believe is the primary determinant for the students' future. Since this test is administered only once a year in November, students and their families devote all the resources they can to prepare for this fateful day.
Seoul, Korea falls silent for college entrance exam (PRI.org 2014-11-13)

An ordinary day
- Government offices and private businesses were closed.

On an exam day
- Car and Flight Bans: Cars banned in area near test centers. No planes flew overhead.
- A hotline for students requiring police escorts, extra 1,500 taxis to give rides.
- The nation has one of the world’s highest youth suicide rates. (And some of the world’s most depressed.)
An example from the tutoring industry in Hong Kong

- Tutoring culture is a big business in Hong Kong
- 1/3 of secondary school students spent about US$2.58 million per month on private tutoring in 2004-2005.
- Private tutoring industry is worth at least US $55 million.
- Other reports claimed that the industry generated more than US$494 million (cp. Uber co-founder and director Travis Kalanick sold about half a billion dollars worth of stock in the first week of November 2019)
“Advertisements for star tutors in Hong Kong can be seen all over here: on billboards that loom over highways and on the exteriors of shopping malls. Invariably, the local teaching celebrities are young, attractive and dressed in designer outfits befitting pop stars. But beyond the polished shine, the advertisements also claim that their celebrity tutors can help students ace Hong Kong’s university entrance exam.”
How has the U.S. “spiral curriculum” been viewed? [WE nurture?]

• The spiral approach is a technique often used in teaching or textbooks where first the basic facts of a subject are learned, without worrying about details. Then as learning progresses, more and more details are introduced, while at the same time they are related to the basics which are reemphasized many times.

e.g. Prime Factorization -> GCF Factoring -> Factoring quadratic expressions with $a = 1$ -> Factoring quadratic expressions with $a \neq 1$ -> Extend factoring to cubic expressions.
A case study of PA schools [WE nurture?]

Method. Focus group discussion with six PA HS math teachers in September 2016.

Findings.

• Homework given to students is largely procedural, similar to Schoenfield’s (1989) description.

• Minimal opportunities for learners to experience disequilibrium when doing homework.
And the U.S. practice
A case study of PA schools

Findings. (Continued)
• Learners tend to resist HW when confronted with disequilibrium
• Parents also tend to resist when they observe their children “stuck” on homework problems.
• School administrators do not generally support the math teachers when learners and parents are pushing back.

Interpretation. The findings are consistent with the belief of natural endowment of math abilities for many U.S. students. [WE say nature, but WE are giving up]
A Canadian view of the math reform [“THEY” perspective]

• Raptis and Baxter (2006) compared the reform efforts among British Columbia, Quebec, and the U.S.

• They argued that the spiral curriculum was merely a fragmentation of computationally-oriented content; hence, it lacks focus – highly repetitive – and does not provide ... a rigorous math and science education by international standards. [THEY gave up -> Nature]

• Hattie’s argument/Analogy of running [THEY -> Nature]
Take away

• Each perspective may show evidence in the individual and collective behaviors that take stances in the nature and nurture beliefs.

• We can examine a phenomenon, like Nature/Nurture through each perspective and may find a multitude of interpretations.

• Are we sending mixed signals to our students?

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