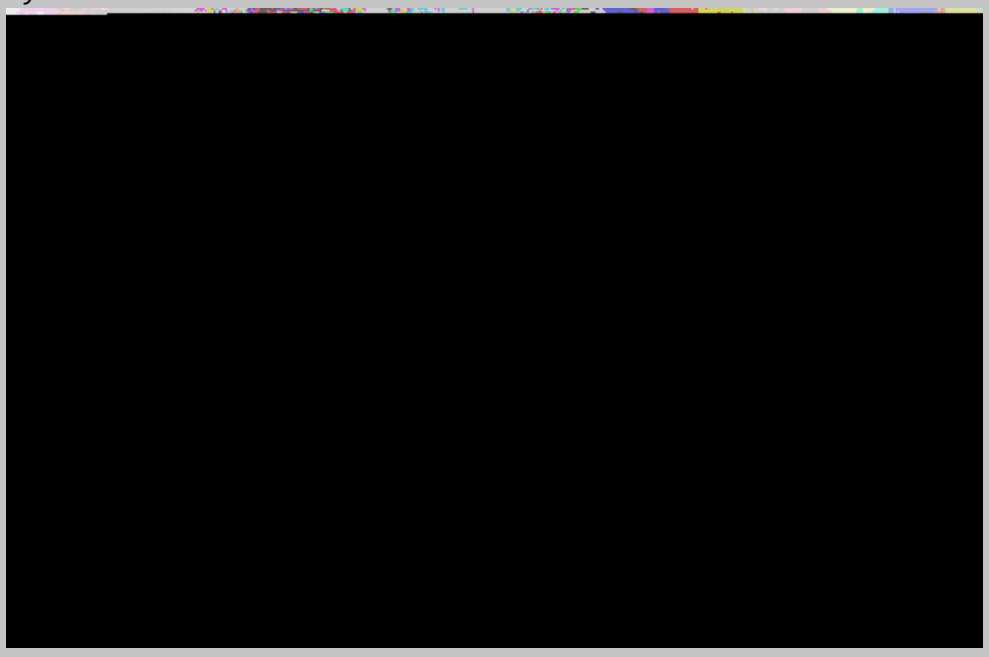
The Stereotypes That Distort How Americans Teach and Learn Math

By Jo Boaler



AP Photo

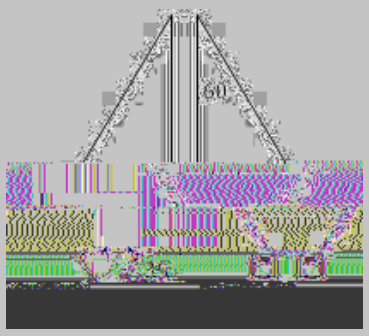
Mathematics education in the United States is broken. Open any newspaper and stories of math failure shout from the pages: low international rankings, widespread innumeracy in the general population, declines in math majors. Here's

One of the reasons for these results is that mathematical problems that need thought, connection making, and even creativity are more engaging for students of all levels and for students of different genders, races, and socio-economic groups. This is not only shown by my research but by decades of research in our field. When all aspects of mathematics are encouraged, rather than procedure execution alone, many more students contribute and feel valued. For example, some students are good at procedure execution, but may be less good at connecting methods, explaining their thinking, or representing ideas visually. All of these ways of working are critical in mathematical work and when they are taught and valued, many more students contribute, leading to higher achievement. I refer to this broadening and opening of the mathematics taught in classrooms as *mathematical democratization*. When we open mathematics we also open the doors of math achievement and many more students succeed.

In mathematics education we suffer from the widespread, distinctly American idea that only some people can be "math people." This idea has been

For example, consider the following two published test questions. The first comes from California's old standards, the second from the Common Core.

1. Which of the following best describes the triangles shown below?



A both similar and congruent

B similar but not congruent

C congruent but not similar

D neither similar nor congruent

California Standards Test, released test questions, geometry, 2009

2. Triangle ABC undergoes a series of some of the following transformations to become triangle DEF:

Rotation
Reflection
Translation
Dilation

Is DEF always, sometimes, or never congruent to ABC? Provide justification to support your conclusion.

Common Core Smarter Balanced Grade 8 Sample Item, 2013

The second question, from one of the Common Core assessment teams, does not simply test a mathematical definition, as the first does. It requires that students visualize a triangle, use transformational geometry, consider whether different cases satisfy the mathematical definition, and then justify their thinkiot combines different areas of o

Mathematicians, by contrast prove the validity of their propositions through justification and reasoning.

Mathematicians are not the only people who need to engage in justification and reasoning. The young people who are successful in today's workforce are those who can discuss and reason about productive mathematical pathways, and who can be wrong, but can trace back to errors and work to correct them. In our new technological world, employers do not need people who can calculate correctly or fast, they need people who can reason about approaches, estimate and verify results 0.2 (e)-0.3 (0.7)-0.2 (e)-0..6(duc}0.2