My Conversion to Tauism

Stephen Abbott

There was no identifiable moment when I said, yes, I believe. My conversion must have come on silently and unexpectedly. I do, however, remember the moment when I realized something had inalterably changed. I was standing at the chalkboard giving a calculus lecture and came across $\cos(\pi/2)$ in the midst of some larger calculation. "The cosine is the x-coordinate of the point on the unit circle," I said to my trusting students, "and we are $1/2$ of the way around the circle, so $\cos(\pi/2) = -1$."

A long pause followed as I listened to my words echo around the room. *Thank heaven I have tenure*, I thought to myself.

For those who have not yet been exposed to this rogue movement to unseat π from its perch atop the list of mathematical constants, let me quickly catch you up. In 2001, Bob Palais wrote a piece for the *Mathematical Intelligencer* entitled "π Is Wrong!" In it, Palais argues that the fundamental circle constant should really be 2π, not π. Palais's article struck a mighty chord with physicist and educator Michael Hartl. With Palais's blessing, Hartl suggested using the Greek letter τ (pronounced "tau") for 2π and penned "The Tau Manifesto," which he posted on the Web (*tauday.com*) on June 28, 2010, and updated one year later on the same date. (Note that June $28 = 6/28$ which is . . . you guessed it, Tau Day.)

"The Tau Manifesto" is an entertaining read, so entertaining in fact that you don't immediately

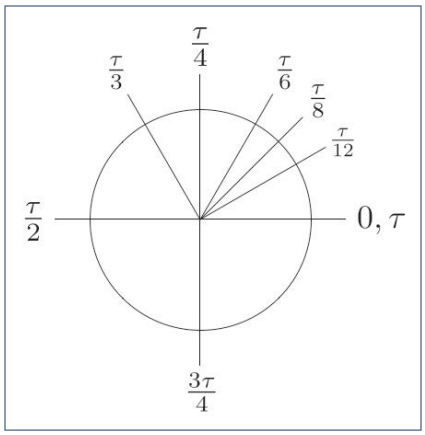

Figure 1.

notice how utterly compelling it is. Why is it that nearly every time π appears in a formula it is preceded by a 2? It's because the geometers of antiquity had a collective moment of shortsightedness that was never corrected. Simply put, dividing a circle's circumference by its *diameter* is a peculiar ratio to consider. The defining feature of a circle is its *radius*, and so $\tau = C/r$ (circumference divided by the radius) is the constant whose digits we should all be memorizing and whose name we should be incorporating into inappropriate puns.

Warning: A look into the world of tauism may make it impossible for you to ever go back to being pious.

As a quick sampler, the sine and cosine are τ-periodic (e.g., $\sin(x+\tau) = \sin(x)$), Euler's formula becomes the pristine $e^{i\tau} = 1$, and the area equation $A = (1/2)\tau r^2$ more proudly announces the fact that it can be derived as the integral of the circumference $C = \tau r$ with respect to the radius. The central reason for this across-the-board uptick in elegance is that the constant τ represents one complete trip around the circle. Indeed, the fact that τ phonetically suggests one full "turn" is Hartl's primary motivation for selecting it—that, and the fact that τ looks a bit like π.

The pedagogical benefits of this transformation are, well, transformative. An angle such as $\tau/4$ becomes—quite reasonably—a fourth of the circle! It's not just simpler; there is something about it that sounds more correct. One quick gander at figure 1 is all it takes to make the current way we teach radian angle measure begin to sound like a Buddhist koan:

Student: When will I achieve trigonometric enlightenment?

Master: When you understand that two pi equals one pie.

The irrationality of π takes on an entirely new meaning when you start to look at things this way.

As Hartl notes, π is monolithic in our culture and will not go easily or quietly. But go it must. Although π has been the subject of books, feature films, biblical debates, and pages upon pages of mathematical lore, it is, in the end, only half the story. ■

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