**Title:** The universe takes sides



**Image caption:** A photograph from the day that Sweden switched from driving on the left to driving on the right [[photo source](http://rarehistoricalphotos.com/dagen-h-day-sweden-switched-sides-road-1967/)]. A physicist might call this a change in [chirality](http://en.wikipedia.org/wiki/Chirality_(mathematics)), since one driving pattern was replaced by its mirror image.

**Main text:**

One morning in 1967, all cars in Sweden had to stop, move over to the right side of the road, wait ten minutes, and then resume driving. From that day forward, Sweden has been a drive-on-the-right country, like its closest neighbors and most of Europe. One may argue that left versus right is pure convention, but conventions are contagious: It's much easier when they match.

People aren't as left-right symmetric as they appear. At an anatomic level, human hearts are slightly on the left and livers are predominantly on the right. The differences are even more striking at a molecular level — molecules and their mirror-image counterparts have completely different biological effects. For instance, the mirror image of the molecule that gives mint its taste is the flavor of caraway seeds. More dramatically, life on Earth is composed purely of left-handed amino acids. Right-handed versions of these molecules exist, but early microbes decided against them.

Still, this seems to be a matter of convention, or at least an accident of evolution. At the most fundamental level, is there a difference between left and right? Surprisingly, the answer seems to be yes. The [weak force](http://www.fnal.gov/pub/today/archive/archive_2013/today13-04-26.html), uniquely among the four fundamental forces, can only be felt by left-handed particles (and right-handed antiparticles). Particle physics interactions involving W bosons simply do not have mirror-image counterparts.

We can make a distinction between a left-handed particle and a right-handed particle by how its [spin](http://www.fnal.gov/pub/today/archive/archive_2012/today12-11-02_NutshellReadMore.html) aligns with its trajectory. If you point the thumb of your right hand in the direction of a particle's motion and your fingers curl in the direction that it spins, then the particle is right-handed and is completely invisible to the weak force. A particle that spins in the direction that your left fingers curl is perfectly susceptible to the weak force.

The idea that a fundamental interaction of the universe would prefer left over right is so strange that some physicists hypothesize that it only looks that way because we're not seeing the whole picture. Suppose that the W boson we know is half of a pair: that there's a W' boson that [only interacts with right-handed particles](http://www.fnal.gov/pub/today/archive/archive_2014/today14-08-08.html), and we haven't discovered it yet because its mass is more than current particle colliders can produce. Curiously, this theory could also explain the small yet nonzero mass of the neutrino.

In this theory, the universe would have no fundamental left-right preference, but slight fluctuations in the early universe made the W boson light and the W' heavy in some regions of space. Once seeded, that asymmetry spread, like the microbes that favored left-handed amino acids and the drivers that favored the right-hand side of the road. If this theory is true, then there could even be parts of the universe where the other convention was chosen, in much the same way that [most island nations](http://en.wikipedia.org/wiki/Right-_and_left-hand_traffic) drive on the left. They get away with it because they're islands.