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Mirror Mirror: Examining Nature's Copy and Paste

BY JOHN DE DIOS

Evolution ▾

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Twins Derek and Zachary Francis sit across from each other in Caffe Luce, a popular coffee shop near the University of Arizona campus. Their faces, still showing signs of youthful hormones, are nearly identical. Their hairstyles, their fashion styles and even their mannerisms are almost mirror images.

Derek, the older brother, has a wider jaw and short hair. A red string adorns his left wrist as he writes left-handed. Zachary, with his short hair coifed similar to his brother's and a small birthmark behind his neck, is more reserved, listening to headphones while he scrolls through his computer with his right hand.

The brothers have spent 99 percent of their 19 years of life at each other's side. They also share an even rarer bond than your typical identical twin: The Francis twins are also mirror-image twins.

Mirror-image twins is an unofficial phenomenon that occurs among identical twins almost 25 percent of the time, according to [Dr. Nancy Segal](#), a psychologist and director of the Twin Studies Center at California State University, Fullerton. In these cases, each twin exhibits a trait that's the opposite of the other twin's. One might be

left-handed, the other right-handed. Or one has freckles on the left cheek, but the other has it on the right. In rare cases, brain structures and areas of expression in diseases like cancer when a co-twin develops a similar cancer on the right lung as their sibling who has had it on the left.

Mirror-image twin is not a recognized designation for identical twins. "It's a misnomer because only some traits are mirrored," Segal said. Segal, who is a 'fraternal' co-twin, a term used on members of twin pairs, has been working with twins since her graduate studies back in the late 1980s. In fact, she is one of the world's foremost researchers on twins. Her latest book on twins raised apart, Born Together - Reared Apart, which was released earlier this summer, examines a case of twins who did not meet each other until they were adults but shared traits including tension headaches, bit fingernails, smoked Salems and even vacationed on the same Florida beach.

Segal calls mirror-image twins a "messy group" in terms of research because they don't have uniformly mirrored traits that make research reproducible. Because of this, conflict has arisen over the mechanics of twindom and some of the results of studies.

Zach and Derek Francis exhibit mirroring traits in their handedness, the part and whorl of their hair growth and even their overbites when they were children. "Zach was in a check-up at the orthodontist, and they found out he had an overbite to the right side of his mouth," said Penelope Francis, the twins' mother. "I told the doctor that Derek must have one to the left."

At first the doctor laughed. When he asked why Francis would assume that, she explained the boys' mirror-image traits.

And she was right about the overbite.

Copy, Paste: A Challenge to Twin Types

Not everyone, however, believes in the mythology about twins - or even the terminology. "There's no such things as identical twins," said Dr. Charles Boklage, a behavioral and developmental genetics researcher at East Carolina University and the father of twin girls. "No two people are identical."

"Monozygotic is what people mean," Boklage continued, insisting on the terms "monozygotic" and "dizygotic" when referring to twins.

In layman's terminology, "monozygotic" means that a single fertilized egg split to create two babies. "Dizygotic" means that two fertilizations occurred, resulting in two siblings who happen to be born at roughly the same time.

In the case of "dizygotic" versus "fraternal," Boklage simply said that "fraternal" means "brother." Twins classified as "fraternal," however, have also been females or have at least one female in the pairing.

Boklage, whose claims dash many myths associated with twin lore including handedness, shared traits, and even the time when twins are formed at conception. He said there's a lack of scientific proof explaining why mirror imaging happens. He argued that the idea first appeared after an experiment in the 1920s by Hans Spemann, a professor at the University of Freiburg and later Nobel Laureate in developmental biology for his work on embryogenesis.

In this experiment, newt embryos were successfully induced to split when Spemann pinched a single embryo into a dumbbell shape using a child's hair. As a result, the normal asymmetry of the new organisms' internal organs was reversed, Boklage said. Spemann did not entirely pinch the embryos in half because this would have killed the embryo.

"Mirror-imaging between twins is real, and it almost certainly means something important about embryogenesis," Boklage wrote in his book *How New Humans Are Made*. "But, any such relationship is entirely accidental and meaningless in this context, the context in which it is most often discussed."

Boklage wrote that handedness, a trait common among mirror twins, "is not representative of most instances of the phenomenon and is therefore very much the wrong place to look for it."

In his research Boklage claimed that the frequency of left-handedness is only slightly higher than among single-born siblings. This trait, he contended, was inherited from parents rather than caused by special splitting at the embryonic level.

"In fact," Boklage wrote, "in most samples collected and studied to date, dizygotic co-twins are, clearly and consistently, considerably more likely to differ in handedness (that is, to "be mirror-image twins") than monozygotic co-twins."

Although Boklage acknowledged that the phenomenon happens, he doesn't believe it is as prominent as what is often cited in popular literature available on the Web. "I can find no source for that 25 percent number in the scientific literature," Boklage wrote in his book. "I believe it has to be a wild arm-waving guess that has been passed along because it is nice to have a number and nobody can readily provide a reference to any evidence that can show that this suggested number is wrong."

Boklage's arguments seem to agree with Penelope Francis, who insisted that her sons Derek and Zach are fraternal - or dizygotic - twins and not identical. Francis said the doctors told her the boys came in "two different sacs."

"Mothers are the worst judges of twindom because they are around the twins all the time," Segal said, "while strangers are rarely around the twins and so can judge them better."

Segal, who is a contributing editor to the journal *Twin Research and Human Genetics*, wrote in a December 2010 article: "[A]bout a third of identical twins were born in separate placentas, amnions (inner fetal membranes) and chorions (outer fetal membranes)." In the article she mentioned the case of the parents who were misinformed about the type of twins their daughters were - a mistake that seems to be made often about the sacs in which twins are born.

Segal also disagreed with Boklage's claims about the lack of scientific evidence for the frequency of mirror-image twins. She cited her own work and a book by Sally P. Springer called *Left Brain, Right Brain* as sources for the 25 percent figure that's commonly associated with the frequency of mirror-image twins.

"It is well known among scientists that monozygotic (identical) twins can differ across virtually every behavioral and physical trait," Segal wrote, "including intelligence, personality, height and weight."

Mirror-image twins Julie and Marie Fleming, 17, from Tucson, are tall, athletic and outgoing teens with a penchant for slight mischief, such as switching places in some of their high school classes. Much like the Francis twins, the Fleming girls differ in height and weight, albeit slightly, and abilities. The girls share similar interests in writing but excel in different sports. Julie is better at volleyball, Marie at basketball.

The girls also exhibit the handedness trait and mirror their eyesight - the prescriptions for the girls' eyes are mirrored in the other, they said.

Seeing Double

In early April twin researchers from all over the world gathered at the Joint 2nd World Congress on Twin Pregnancy and the 14th Congress of the International Society of Twin Studies in Florence, Italy. The scientists presented work that was going in several directions, Segal said.

Some western countries have shown a growing frequency in twin birth, Segal said. In the United States alone, twinning rates rose by 76 percent between 1980 and 2009. In 2009, one in every 30 infants born was a twin, according to a brief issued in January 2012 by the National Center for Health Statistics at the CDC.

Now, researchers are looking at twins for epigenetics, looking for specific genes for specific diseases. Twins are perfect candidates for this research because researchers can examine which genes are expressed or not expressed among the twins, Segal said.

Twins are also favored in the study of environmental effects on humans because of a similar reason - in theory, identical twins give researchers the ability to study how environmental stimuli affect humans, using one twin as the control.

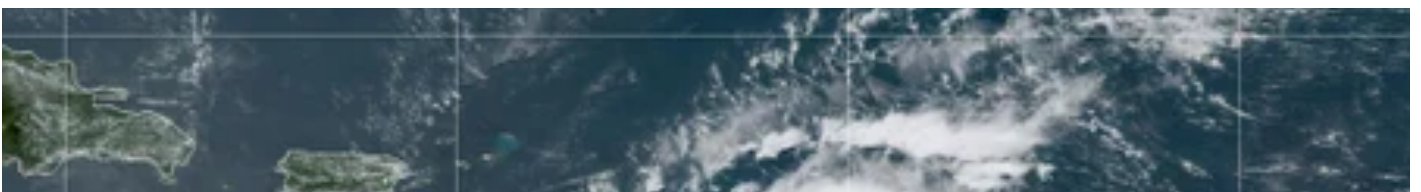
"[Twin research is] the most simple, but elegant way to study human behavior," Segal said.

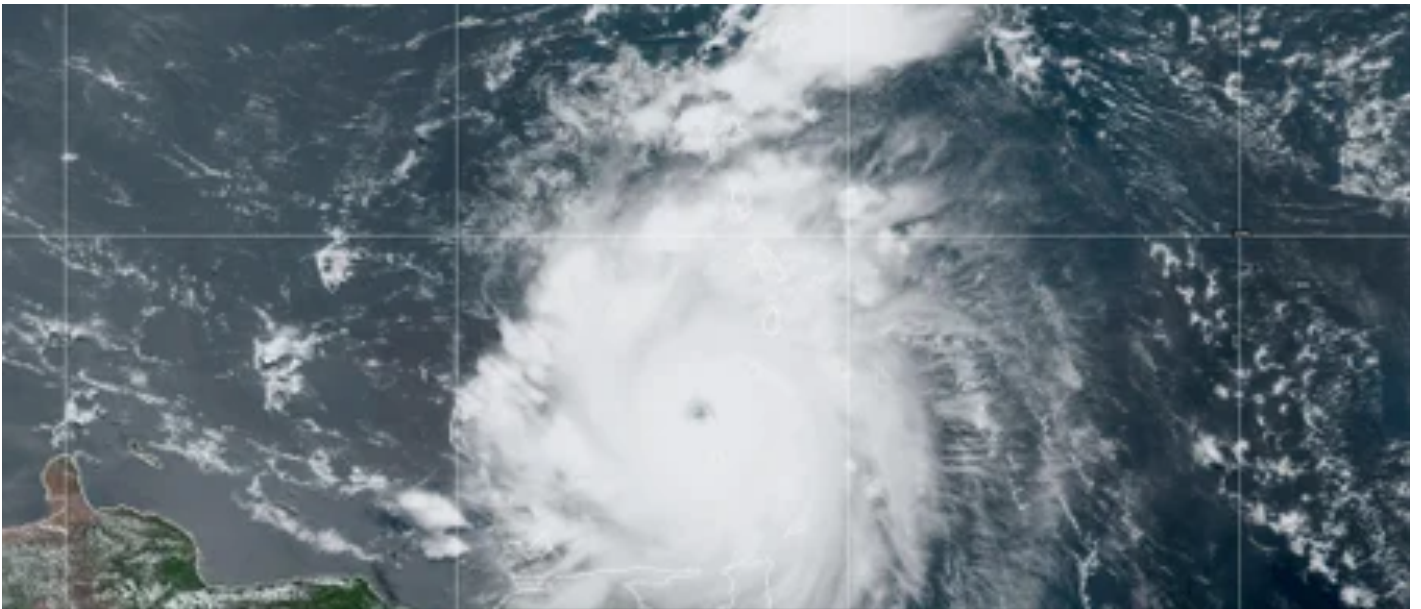
ABOUT JOHN DE DIOS

John de Dios is a journalist from Tucson, Ariz. De Dios has worked on written, audio, video, and photo stories for the last 10 years. De Dios served as a mentor for The New York Times Student Journalism Institute in Tucson, serving on the web, layout, photo, and multimedia desks. De Dios is very much involved in the diversity journalism organizations, mentoring for the UNITY Convention in Chicago in 2008 and again in Las Vegas in August of this year. De Dios is also a member of the National Association of Science Writers. De Dios serves as the social media coordinator for Reporting Unlimited with Mort Rosenblum, a veteran international and environmental journalist. De Dios is also an avid fan of horror movies and a tremendous dog lover.

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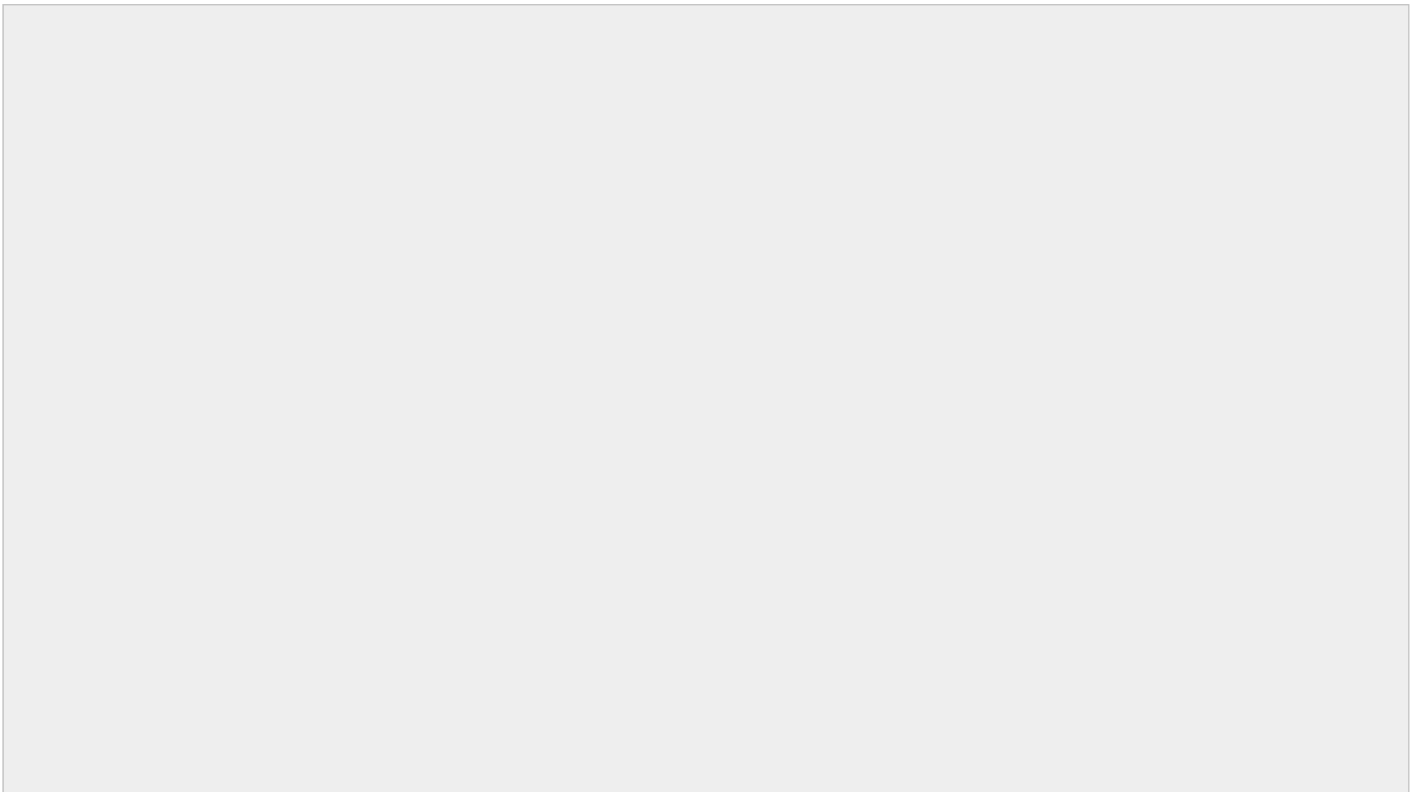


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