MAGAZINE GENDER REVOLUTION

How science is helping us understand gender

Freed from the binary of boy and girl, gender identity is a shifting landscape. Can science help us navigate?

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This story has been republished on October 22, 2018 in light of the Trump administration's attempt to limit the concept of gender to female and male, excluding those who feel this is an inadequate way to describe their gender identity. This story appears in the January 2017 issue of *National Geographic* magazine.

She has always felt more boyish than girlish.

From an early age, E, as she prefers to be called for this story, hated wearing dresses, liked basketball, skateboarding, video games. When we met in May in New York City at an end-of-the-year show for her high school speech team, E was wearing a tailored Brooks Brothers suit and a bow tie from her vast collection. With supershort red hair, a creamy complexion, and delicate features, the 14-year-old looked like a formally dressed, earthbound Peter Pan.

Later that evening E searched for the right label for her gender identity. "Transgender" didn't quite fit, she told me. For one thing she was still using her birth name and still preferred being referred to as "she." And while other trans kids often talk about how they've always known they were born in the "wrong" body, she said, "I just think I need to make alterations in the body I have, to make it feel like the body I need it to be." By which she meant a body that doesn't menstruate and has no breasts, with more defined facial contours and "a ginger beard." Does that make E a trans guy? A girl who is, as she put it, "insanely androgynous"? Or just someone who rejects the trappings of traditional gender roles altogether?

You've probably heard a lot of stories like E's recently. But that's the whole point: She's questioning her gender identity, rather than just accepting her hobbies and wardrobe choices as those of a tomboy, because we're talking so much about transgender issues these days. These conversations have led to better head counts of transgender Americans, with a doubling, in just a decade, of adults officially tallied as transgender in national surveys; an increase in the number of people who are gender nonconforming, a broad category that didn't even have a name a generation ago; a rise in the number of elementary school–age children questioning what gender they are; and a growing awareness of the extremely high risk for all of these people to be bullied, to be sexually assaulted, or to attempt suicide.

The conversation continues, with evolving notions about what it means to be a woman or a man and the meanings of transgender, cisgender, gender nonconforming, genderqueer, agender, or any of the more than 50 terms Facebook offers users for their profiles. At the same time, scientists are uncovering new complexities in the biological understanding of sex.

Many of us learned in high school biology that sex chromosomes determine a baby's sex, full stop: XX means it's a girl; XY means it's a boy. But on occasion, XX and XY don't tell the whole story.

Today we know that the various elements of what we consider "male" and "female" don't always line up neatly, with all the XXs—complete with ovaries, vagina, estrogen, female gender identity, and feminine behavior—on one side and all the XYs—testes, penis, testosterone, male gender identity, and masculine behavior—on the other. It's possible to be XX and mostly male in terms of anatomy, physiology, and psychology, just as it's possible to be XY and mostly female.

Each embryo starts out with a pair of primitive organs, the proto-gonads, that develop into male or female gonads at about six to eight weeks. Sex differentiation is usually set in motion by a gene on the Y chromosome, the *SRY* gene, that makes the proto-gonads turn into testes. The testes then secrete testosterone and other male hormones (collectively called androgens), and the fetus develops a prostate, scrotum, and penis. Without the *SRY* gene, the proto-gonads become ovaries that secrete estrogen, and the fetus develops female anatomy (uterus, vagina, and clitoris).

But the *SRY* gene's function isn't always straightforward. The gene might be missing or dysfunctional, leading to an XY embryo that fails to develop male anatomy and is identified at birth as a girl. Or it might show up on the X chromosome, leading to an XX embryo that does develop male anatomy and is identified at birth as a boy.

Genetic variations can occur that are unrelated to the *SRY* gene, such as complete androgen insensitivity syndrome (CAIS), in which an XY embryo's cells respond minimally, if at all, to the signals of male hormones. Even though the proto-gonads become testes and the fetus produces androgens, male genitals don't develop. The baby looks female, with a clitoris and vagina, and in most cases will grow up feeling herself to be a girl.

Which is this baby, then? Is she the girl she believes herself to be? Or, because of her XY chromosomes—not to mention the testes in her abdomen—is she "really" male?

Georgiann Davis, 35, was born with CAIS but didn't know about it until she stumbled upon that information in her medical records when she was nearly 20. No one had ever mentioned her XY status, even when doctors identified it when she was 13 and sent her for surgery at 17 to remove her undescended testes. Rather than reveal what the operation really was for, her parents agreed that the doctors would invent imaginary ovaries that were precancerous and had to be removed.

In other words, they chose to tell their daughter a lie about being at risk for cancer rather than the truth about being intersex—with reproductive anatomy and genetics that didn't fit the strict definitions of female and male.

"Was having an intersex trait that horrible?" wrote Davis, now a sociologist at the University of Nevada, Las Vegas, in *Contesting Intersex: The Dubious Diagnosis*. "I remember thinking I must be a real freak if even my parents hadn't been able to tell me the truth."

Another intersex trait occurs in an isolated region of the Dominican Republic; it is sometimes referred to disparagingly as *guevedoce*—"penis at 12." It was first formally studied in the 1970s by Julianne Imperato-McGinley, an endocrinologist from the Weill Cornell Medical College in New York, who had heard about a cohort of these children in the village of Las Salinas. Imperato-McGinley knew that ordinarily, at around eight weeks gestational age, an enzyme in male embryos converts testosterone into the potent hormone DHT. When DHT is present, the embryonic structure called a tubercle grows into a penis; when it's absent, the tubercle becomes a clitoris. Embryos with this condition, Imperato-McGinley revealed, lack the enzyme that converts testosterone to DHT, so they are born with genitals that appear female. They are raised as girls. Some think of themselves as typical girls; others sense that something is different, though they're not sure what.

But the second phase of masculinization, which happens at puberty, requires no DHT, only a high level of testosterone, which these children produce at normal levels. They have a surge of it at about age 12, just as most boys do, and experience the changes that will turn them into men (although they're generally infertile): Their voices deepen, muscles develop, facial and body hair appear. And in their case, what had at first seemed to be a clitoris grows into a penis.

When Imperato-McGinley first went to the Dominican Republic, she told me, newly sprouted males were suspect and had to prove themselves more emphatically than other boys did, with impromptu rituals involving blades, before they were accepted as real men.

Today these children are generally identified at birth, since parents have learned to look more carefully at newborns' genitals. But they are often raised as girls anyway.

Gender is an amalgamation of several elements: chromosomes (those X's and Y's), anatomy (internal sex organs and external genitals), hormones (relative levels of testosterone and estrogen), psychology (self-defined gender identity), and culture (socially defined gender behaviors). And sometimes people who are born with the chromosomes and genitals of one sex realize that they are transgender, meaning they have an internal gender identity that aligns with the opposite sex—or even, occasionally, with neither gender or with no gender at all.

As transgender issues become the fare of daily news—Caitlyn Jenner's announcement that she is a trans woman, legislators across the United States arguing about who gets to use which bathroom—scientists are making their own strides, applying a variety of perspectives to investigate what being transgender is all about.

In terms of biology, some scientists think it might be traced to the syncopated pacing of fetal development. "Sexual differentiation of the genitals takes place in the first two months of pregnancy," wrote Dick Swaab, a researcher at the Netherlands Institute for Neuroscience in Amsterdam, "and sexual differentiation of the brain starts during the second half of pregnancy." Genitals and brains are thus subjected to different environments of "hormones, nutrients, medication, and other chemical substances," several weeks apart in the womb, that affect sexual differentiation.

This doesn't mean there's such a thing as a "male" or "female" brain, exactly. But at least a few brain characteristics, such as density of the gray matter or size of the hypothalamus, do tend to differ between genders. It turns out transgender people's brains may more closely resemble brains of their self-identified gender than those of the gender assigned at birth. In one study, for example, Swaab and his colleagues found that in one region of the brain, transgender women, like other women, have fewer cells associated with the regulator hormone somatostatin than men. In another study scientists from Spain conducted brain scans on transgender men and found that their white matter was neither typically male nor typically female, but somewhere in between.

These studies have several problems. They are often small, involving as few as half a dozen transgender individuals. And they sometimes include people who already have started taking hormones to transition to the opposite gender, meaning that observed brain differences might be the result of, rather than the explanation for, a subject's transgender identity.

Still, one finding in transgender research has been robust: a connection between gender nonconformity and autism spectrum disorder (ASD). According to John Strang, a pediatric neuropsychologist with the Center for Autism Spectrum Disorders and the Gender and Sexuality Development Program at Children's National Health System in Washington, D.C., children and adolescents on the autism spectrum are seven times more likely than other young people to be gender nonconforming. And, conversely, children and adolescents at gender clinics are six to 15 times more likely than other young people to have ASD.

Emily Brooks, 27, has autism and labels herself nonbinary, though she has kept her birth name. A slender person with a half-shaved head, turquoise streaks in her blond hair, and cute hipster glasses, Brooks recently finished a master's degree at the City University of New York in disability studies and hopes eventually to create safer spaces for people who are gender nonconforming (which she defines quite broadly) and also have autism. Such people are battling both "ableism" and "transphobia," she told me over soft drinks at a bar in midtown Manhattan. "And you can't assume that a place that's going to be respectful of one identity will be respectful of the other."

As I sat with Brooks, talking about gender and autism, the bartender came over. "What else can I get you ladies?" he asked. Brooks bristled at being called a lady—evidence that her own search for a safe space is complicated not only by her autism but also by her rejection of the gender binary altogether.

There's something to be said for the binary. The vast majority of people—more than 99 percent, it seems safe to say—put themselves at one end of the gender spectrum or the other. Being part of the gender binary simplifies the either-or of daily life: clothes shopping, sports teams, passports, the way a bartender asks for your order.

But people today—especially young people—are questioning not just the gender they were assigned at birth but also the gender binary itself. “I don’t relate to what people would say defines a girl or a boy,” Miley Cyrus told *Out* magazine in 2015, when she was 22, “and I think that’s what I had to understand: Being a girl isn’t what I hate; it’s the box that I get put into.”

Members of Cyrus’s generation are more likely than their parents to think of gender as nonbinary. A recent survey of a thousand millennials ages 18 to 34 found that half of them think “gender is a spectrum, and some people fall outside conventional categories.” And a healthy subset of that half would consider themselves to be nonbinary, according to the Human Rights Campaign. In 2012 the advocacy group polled 10,000 lesbian, gay, bisexual, and transgender teens ages 13 to 17 and found that 6 percent categorized themselves as “genderfluid,” “androgynous,” or some other term outside the binary box.

Young people trying to pinpoint their own place on the spectrum often choose a pronoun they’d like others to use when referring to them. Even if they don’t feel precisely like a girl or a boy, they might still use “he” or “she,” as Emily Brooks does. But many opt instead for a gender-neutral pronoun like “they” or an invented one like “zie.”

Charlie Spiegel, 17, tried using “they” for a while, but now prefers “he.” Charlie was assigned female at birth. But when he went through puberty, Charlie told me by phone from his home in Oakland, California, being called a girl started to feel unsettling. “You know how sometimes you get a pair of shoes online,” he explained, “and it arrives and the label says it should be the right size, and you’re trying it on and it’s clearly not the right size?” That’s how gender felt to Charlie: The girl label was supposed to fit, but it didn’t.

One day during freshman year, Charlie wandered into the school library and picked up *I Am J* by Cris Beam, a novel about a transgender boy. “Yep, that sounds like me,” Charlie thought as he read it. The revelation was terrifying but also clarifying, a way to start making those metaphoric mail-order shoes less uncomfortable.

A better fitting gender identity didn’t come along right away, though. Charlie—a member of the Youth Council at Gender Spectrum, a national support and advocacy group for transgender and nonbinary teens—went through a process of trial and error similar to that described by other gender-questioning teens. First he tried “butch lesbian,” then “genderfluid,” before settling on his current identity, “nonbinary trans guy.” It might sound almost like an oxymoron—aren’t “nonbinary” and “guy” mutually exclusive?—but the combination feels right to Charlie. He was heading off to college a few months after our conversation, getting ready to start taking testosterone.

If more young people are coming out as nonbinary, that’s partly because the new awareness of the nonbinary option offers “a language to name the source of their experience,” therapist Jean Malpas said when we met last spring at the Manhattan offices of the Ackerman Institute for the Family, where he directs the Gender and Family Project.

But as more children say they’re nonbinary—or, as Malpas prefers, “gender expansive”—parents face new challenges. Take E, for example, who was still using female pronouns when we met in May, while struggling over where exactly to place herself on the gender spectrum. Her mother, Jane, was struggling too, trying to make it safe for E to be neither typically feminine nor typically masculine.

The speech team that had performed in New York City the night E and I met was getting ready to travel to a national competition in California, and Jane showed me the email she’d sent the coach to pave the way. E might be seen by others as male, Jane wrote, now that her hair was so short and her clothing so androgynous. She would probably use “both male and female bathrooms depending on what situation feels safest,” Jane informed the coach, and “will need to tell you when she is going to the restroom and what gender she plans on using.” I asked Jane, the night we met, where she’d place her daughter on the gender spectrum. “I think she wants to fall into a neutral space,” she replied.

A “neutral space” is a hard thing for a teenager to carve out: Biology has a habit of declaring itself eventually. Sometimes, though, biology can be put on hold for a while with puberty-blocking drugs that can buy time for gender-questioning children. If the child reaches age 16 and decides he or she is not transgender after all, the effects of puberty suppression are thought to be reversible: The child stops taking the blockers and matures in the birth sex. But for children who do want to transition at 16, having been on blockers

might make it easier. They can start taking cross-sex hormones and go through puberty in the preferred gender—without having developed the secondary sex characteristics, such as breasts, body hair, or deep voices, that can be difficult to undo.

The Endocrine Society recommends blockers for adolescents diagnosed with gender dysphoria. Nonetheless, the blockers' long-term impact on psychological development, brain growth, and bone mineral density are unknown—leading to some lively disagreement about using them on physically healthy teens.

More fraught than the question about puberty blockers is the one about whether too many young children, at too early an age, are being encouraged to socially transition in the first place.

Eric Vilain, a geneticist and pediatrician who directs the UCLA Center for Gender-Based Biology, says that children express many desires and fantasies in passing. What if saying "I wish I were a girl" is a feeling just as fleeting as wishing to be an astronaut, a monkey, a bird? When we spoke by phone last spring, he told me that most studies investigating young children who express discomfort with their birth gender suggest they are more likely to turn out to be cisgender (aligned with their birth-assigned gender) than trans—and relative to the general population, more of these kids will eventually identify as gay or bisexual.

"If a boy is doing things that are girl-like—he wants long hair, wants to try his mother's shoes on, wants to wear a dress and play with dolls—then he's saying to himself, 'I'm doing girl things; therefore I must be a girl,' " Vilain said. But these preferences are gender expression, not gender identity. Vilain said he'd like parents to take a step back and remind the boy that he can do all sorts of things that girls do, but that doesn't mean he is a girl.

At the Gender and Family Project, Jean Malpas said counselors "look for three things in children who express the wish to be a different gender": that the wish be "persistent, consistent, and insistent." And many children who come to his clinic meet the mark, he told me, even some five-year-olds. "They've been feeling this way for a long time, and they don't look back."

That was certainly the case for the daughter of Seattle writer Marlo Mack (the pseudonym she uses in her podcasts and blogs to protect her child's identity). Mack's child was identified at birth as a boy but by age three was already insisting he was a girl. Something went wrong in your tummy, he told his mother, begging to be put back inside for a do-over.

As Vilain might have instructed, Mack tried to broaden her child's understanding of how a boy could behave. "I told my child over and over again that he could continue to be a boy and play with all the Barbies he wanted and wear whatever he liked: dresses, skirts, all the sparkles money could buy," Mack said in her podcast, *How to Be a Girl*. "But my child said no, absolutely not. She was a girl."

Finally, after a year of making both of them "miserable," Mack let her four-year-old choose a girl's name, start using female pronouns, and attend preschool as a girl. Almost instantly the gloom lifted. In a podcast that aired two years after that, Mack reported that her transgender daughter, age six, "loves being a girl probably more than any girl you've ever met."

Vilain alienates some transgender activists by saying that not every child's "I wish I were a girl" needs to be encouraged. But he insists that he's trying to think beyond gender stereotypes. "I am trying to advocate for a wide variety of gender expressions," he wrote in a late-night email provoked by our phone conversation, "which can go from boys or men having long hair, loving dance and opera, wearing dresses if they want to, loving men, none of which is 'making them girls'—or from girls shaving their heads, being pierced, wearing pants, loving physics, loving women, none of which is 'making them boys.' "

This is where things get murky in the world of gender. Young people such as Mack's daughter, or Charlie Spiegel of California, or E of New York City, must make biological decisions that will affect their health and happiness for the next 50 years. Yet these decisions run headlong into the maelstrom of fluctuating gender norms.

"I guess people would call me gender-questioning," E said the second time we met, in June. "Is that a thing? It sounds like a thing." But the "questioning" couldn't go on forever, she knew, and she was already leaning toward "trans guy." E had moved a few steps closer to that by September, asking people, including me, to use the pronoun "they" when referring to them. If E does eventually settle on a male

identity, they feel it won't be enough just to live as a man, changing pronouns (either sticking with "they" or switching to "he") and changing their name (the leading candidate is the name "Hue"). It would mean becoming physically male too, which would involve taking testosterone. It was all a bit much, E told me. As their 15th birthday approached, they were giving themselves another year to figure it all out.

E's thinking about where they fit on the gender spectrum takes the shape it does because E is a child of the 21st century, when concepts like transgender and gender nonconforming are in the air. But their options are still constrained by being raised in a Western culture, where gender remains, for the vast majority, an either-or. How different it might be if E lived where a formal role existed that was neither man nor woman but something in between—a role that constitutes another gender.

There are such places all over the world: South Asia (where a third gender is called *hijra*), Nigeria *(yan daudu),* Mexico *(muxe),* Samoa *(fa'afafine),* Thailand *(kathoey),* Tonga *(fakaleiti),* and even the U.S., where third genders are found in Hawaii *(mahu)* and in some Native American peoples (two-spirit). The degree to which third genders are accepted varies, but the category usually includes anatomical males who behave in a feminine manner and are sexually attracted to men, and almost never to other third-gender individuals. More rarely, some third-gender people, such as the *burrnesha* of Albania or the *fa'afatama* of Samoa, are anatomical females who live in a masculine manner.

I met a dozen or so fa'afafine last summer, when I traveled to Samoa at the invitation of psychology professor Paul Vasey, who believes the Samoan fa'afafine are among the most well-accepted third gender on Earth.

Vasey, professor and research chair of psychology at the University of Lethbridge in Alberta, Canada, returns to Samoa so frequently that he has his own home, car, and social life there. One thing that especially intrigues him about third genders, in Samoa and elsewhere, is their ability to shed light on the "evolutionary paradox" of male same-sex attraction. Since fa'afafine almost never have children of their own, why are they still able to pass along the genes associated with this trait? Without offspring, shouldn't natural selection pretty much have wiped them out?

Being fa'afafine runs in families, the same way being gay does, Vasey said. (He said it also occurs at about the same rate as male homosexuality in many Western countries, in about 3 percent of the population.) He introduced me to Jossie, 29, a tall, slim schoolteacher. Jossie lives in a village about an hour from the capital, Apia. She giggled at my questions, especially when I asked about guys. For Jossie, being fa'afafine is also a family trait. Several fa'afafine relatives listened to our conversation: Jossie's uncle Andrew, a retired nurse who goes by the name Angie; her cousin Trisha Tuiloma, who is also Vasey's research assistant; and Tuiloma's five-year-old nephew.

"In this village they don't really like the 'fa'fa' style," said Angie, who emerged from the house she shares with Jossie wearing nothing but a long skirt, called a lavalava, tied at the waist. Back in her 20s Angie had thought it might be nice "to have an operation to be a woman." But now, at 57, she said she's happy without surgery. She no longer feels discriminated against. Fellow church parishioners might criticize the way she and Jossie dress or behave, but "our families here, they understand."

Vasey is now investigating two hypotheses that might explain the evolutionary paradox of male same-sex sexuality.

The first, the sexually antagonistic gene hypothesis, posits that genes for sexual attraction to males have different effects depending on the sex of the person carrying them: Instead of coming with a reproductive cost, as happens in males, the genes in females have a reproductive benefit—which means that the females with those genes should be more fertile. Vasey and his colleagues have found that the mothers and maternal grandmothers of fa'afafine do have more babies than the mothers and grandmothers of straight Samoan men. But they haven't found comparable evidence among paternal grandmothers—or among the aunts of fa'afafine, which would come closest to definitive proof.

A second possibility is the kin selection hypothesis—the idea that the time and money that same-sex-attracted males devote to nurturing their nieces and nephews make it more likely that the nieces and nephews will pass some of their DNA down to the next generation.

Indeed, among the fa‘afafine Vasey introduced me to, several have taken siblings’ children under their wing. Trisha Tuiloma, who is 42, uses the money she earns as Vasey’s research assistant to pay for food, schooling, treats, even electricity for eight nieces and nephews. And in his formal research Vasey has found that fa‘afafine are more likely to offer money, time, and emotional support to their siblings’ children—especially to their sisters’ youngest daughters—than are straight Samoan men or Samoan women.

One other point about gender identity became clear when I met Vasey’s longtime partner, Alatina Ioelu, a fa‘afafine Vasey met 13 summers ago. When Ioelu first drove up to my hotel, my understanding of what it means to be fa‘afafine started to unravel. Ioelu was much more masculine than the other fa‘afafine I’d met. Tall, broad-shouldered, with an open, handsome face, he favored the same clothing—cargo shorts and T-shirts—that Vasey wore. What did it mean for someone who reads as a man to belong to a third gender that implies heightened femininity?

Gradually it dawned on me, as the three of us chatted through dinner, that Ioelu’s identity as a fa‘afafine shows how deeply bound in culture gender itself is. Vasey and Ioelu plan to marry and retire in Canada someday. (Vasey is 50; Ioelu is 38.) “There we’d be perceived as an ordinary same-sex couple,” Vasey told me.

In other words, the gender classification of Ioelu would change, as if by magic, from fa‘afafine to gay man, just by crossing a border.

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