

BIOLOGY

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SEX IS A SPECTRUM: The Biological Limits of the Binary by Agustín Fuentes. Princeton University Press, 2025. 216 pages. Hardcover; \$23.84. ISBN: 9780691249414.

The debate over sex and gender shows no signs of subsiding, and numerous books have emerged addressing this issue from philosophical, theological, and scientific perspectives. This book is an addition to the field, coming from an evolutionary anthropological perspective. Agustín Fuentes is a professor of anthropology at Princeton University. He has a longstanding interest in human evolution, having written several books on this topic. In this book, like his others, Fuentes addresses common misconceptions about humans. Here, his agenda is to dismantle the (mis)conception that males and females are fundamentally different kinds of people. Although he acknowledges some fundamental differences between the sexes, he frames them in such a way that they don't seem to matter, leading to his conclusion that sex is not binary but is on a spectrum. On the one hand, I applaud his efforts to dismantle the "men are from Mars and women are from Venus" view, which leads to bias and discrimination. However, although many features of men and women do overlap, the essentials of sex (i.e., reproductive functions) are still binary.

This is not a large book, and it is intended for a lay audience. Fuentes begins by discussing the evolution of sexual reproduction, first with different mating types (yeast), followed by a discussion of anisogamy (large and small gametes), and then devoting most of the book to the human context. Along the way, Fuentes tends to avoid using the terms "male" and "female," instead calling them a "small (or large) gamete producer" or by qualifying the words with the modifier "3G" (genes, gonads, genitalia) when discussing sex in humans.

There is much that is helpful in this book, in which Fuentes dismantles incorrect stereotypes. We see how varied sex determination and sexual development can be, especially in animals. We also see that the extent of variation of many features *within* a sex generally exceeds the differences *between* sexes, so that there is considerable overlap between the two sexes. When we look at humans, the story is even more complicated because the social aspects of humans add more diversity. Although there is some sexual dimorphism in humans, there is a wide range of variation, such that we cannot use body size, physical strength, or even personality to predict whether someone is male or female.

Fuentes spends some time dismantling the idea that there is such thing as a male or female brain, which

ironically is an argument used by many to support the existence of transgender persons. The question of brain sex is a complex one because different hormonal environments in males and females do influence the brain and behavior. The spectrum of male and female behaviors largely overlaps, and we must acknowledge cultural conditioning, which affects males and females differently.

Given the amount of attention paid to questions of gender lately, I found it surprising that Fuentes spent little time discussing gender. He defines gender as "a set of expectations, perceptions, and behavior that a social group believes about how bodies and behavior *should be* in relation to aspects of sex biology" (p. 68, italics original). He also describes how those expectations can change over time. This should be a warning to us, especially as Christians, to be careful about assigning gender roles as something that is based on one's sex.

In his desire to describe sex as a spectrum rather than binary, Fuentes includes examples of intersex individuals, those with differences of sexual development (DSDs), i.e., those who are not 3G males or females. Here we get into the question of what constitutes normal variation and what is a disorder. While there is diversity in sexual development, a biological condition that makes it impossible for someone to reproduce (for many different reasons, depending on the condition) should be described as a *disorder* of sexual development, not merely a difference, and thus these cases should not be used to argue that sex is a spectrum.

One intersex example that Fuentes cites is the case of South African runner Caster Semenya, whom Fuentes describes as female, even though only one of Semenya's three "Gs" is female (Semenya is XY, has undescended testes, and produces testosterone in the male range). This leads to a discussion about who may participate in women's sports. Women's sports leagues are typically established separately from men's to ensure fair and competitive environments, acknowledging the average physical differences that arise from hormonal and developmental changes during puberty. Among other things, testosterone enhances muscle mass in men and increases the proportion of red blood cells in the blood. Although Fuentes accepts that point, he then argues that Semenya should be allowed to compete as a woman because defining what a woman is by testosterone production "reflects a social construct of what the 'correct' range of testosterone should be" (p. 144).

Fuentes then discusses transgender athletes competing in women's sports. He rightly points out that athletic training for women is generally underfunded and thus women often do not reach their full athletic potential. Yet even if they did so, they would not be able to

compete at the same level as men in sports that require physical strength. He acknowledges that there are some examples of transgender women who would have a competitive edge but maintains that using such a small proportion of people in an already small population of elite athletes as the “key group to understand human-wide patterns of sex biology is misleading and faulty science” (p. 146).

The major point Fuentes makes in this book is that “sex involves *all* the processes of sexual reproduction—not just gametes” (p. 38). That is true, but despite the overlapping ranges for many sexual aspects of men and women, some aspects of sex biology are inescapably binary. The gametes one produces are either large (eggs) or small (sperm). DSDs notwithstanding, only one sex can gestate a baby. This does not make men and women fundamentally different kinds. After all, most of our genetic inheritance is the same in both sexes, and sexual differentiation does not begin until six weeks of development under hormonal influence. However, when it comes to reproduction, sex is clearly binary. Broadening the definition of sex to include behavioral and cultural aspects (i.e., redefining sex to mean gender), as Fuentes does, gives the impression that sex is a spectrum but, from a biological perspective, sex is first and foremost about reproduction.

Overall, *Sex is a Spectrum* presents many good arguments that dispel the idea that males and females are fundamentally different. However, Christians should be aware of Fuentes’s agenda. He focuses on sociological aspects of sex (which are on a spectrum) and minimizes binary biological differences. Moreover, one must be cautious in applying what happens in animals to that in humans. Is sex binary or on a spectrum? Many processes of sex are indeed on a spectrum or bimodal, but the reproductive aspects of sex are inescapably binary.

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EVOLUTIONARY THEORY

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BEYOND EVOLUTION: How New Discoveries in the Science of Life Point to God by Sy Garte. Tyndale Refresh, 2025. 304 pages, including technical details, glossary, and notes. Hardcover; \$19.98. ISBN: 9798400501364.

Sy Garte is an accomplished biochemist who has been a professor at New York University, University of Pittsburgh, and Rutgers University. His work has been widely published in peer-reviewed scientific journals. He is the author of numerous essays and blogs exploring the integration of science and Christian faith, and of two previous books, *The Works of His Hands* (Kregel, 2019)

and *Science and Faith in Harmony* (Kregel, 2024), plus a chapter in the book, *Coming to Faith Through Dawkins*, ed. Denis Alexander and Alister McGrath (Kregel, 2023).

Beyond Evolution is his newest book exploring faith and science. Here Garte poses provocative questions and makes many bold claims. He makes it crystal clear that he accepts evolutionary theory but is critical, however, of neo-Darwinism. The author argues that the neo-Darwinian (modern synthesis) form of evolution has been overemphasized in public discourse; this explains why evolution is such a flash point for many Christians. He suggests that too many Christians and scientists treat evolution almost as a metaphysical worldview rather than a tool for understanding life’s diversity.

In chapter 2, Garte starts to build his argument by pointing out deficits in evolutionary theory. For example, it cannot frame fitness mathematically, which makes the theory susceptible to misuse, and it is insufficient to explain the origin of life. Furthermore, new research suggests that epigenetic changes are long lasting, perhaps permanent, and mutations are not completely random; bacteria have some degree of control (by mechanisms yet unknown) over where mutations occur, thereby enhancing their survival.

According to Garte, evolution by natural selection is not the most fundamental principle in biology, a claim he explores in chapter 3. Instead, high-accuracy self-replication (HASR), or biological inheritance, provides a more foundational insight into life than simple variation and natural selection. He believes evolution is an inevitable consequence of HASR and claims that HASR could not have evolved by natural selection and is therefore strong evidence for God.

I found the most provocative arguments and claims in chapter 4 in which Garte explores agency, cognition, and teleology in biology (ACT). He claims that all living things are agents (A) or entities that act intentionally in goal-oriented ways. The author refers to teleology (T) as explanations that consider the purpose or end of something. Here he makes bold statements that may require a new understanding of purpose. Garte says that “no rock cares about being eroded ... but bacteria, oak trees, and dolphins *do* care” (p. 85, italics in original). Some readers may need to remind themselves that the goal-oriented purpose Garte describes includes simply staying alive and reproducing. Although he blends cognition (C) into his teleology argument, he explores cognition most deeply at the end of chapter 4. He quotes Andreas Wagner in defining cognition as “the mechanisms by which animals acquire, process, store, and act on information from the environment” (pp. 94–95).¹ These mechanisms include perception, learning, memory, and decision-making. The author cites several examples