“The Science and Ethics of Making Part-Human Animals in Stem Cell Biology” (2006), by Jason Scott Robert

In 2006, bioethicist Jason Scott Robert published “The Science and Ethics of Making Part-Human Animals in Stem Cell Biology” in The FASEB Journal. There, he reviews the scientific and ethical justifications and restrictions on creating part-human animals. Robert describes part-human animals, otherwise known as chimeras, as those resulting from the intentional combination of human and nonhuman cells, tissues, or organs at any stage of development. He specifically criticizes restrictions against creating part-human animals made by the National Academy of Sciences, or NAS, in 2005, arguing that while they ensure that such research is morally justifiable, they might limit scientists from conducting useful science using part-human animals or entities. Robert challenges the moral rationales behind prohibiting chimera research, arguing that they may impede scientists from conducting research that could have important benefits to biology and medicine, and suggests how to balance the conflicting moral and scientific needs of such science.

In “The Science and Ethics of Making Part-Human Animals in Stem Cell Biology,” Robert states that he intentionally avoids using the word chimera, opting to instead refer to the organisms as part-human entities or animals generated through the merging of human and nonhuman cells, tissues, or organs. The word chimera derives from a part-human creature in Greek mythology that has body parts from a lion, goat, and snake. In biology, the term chimera refers to an organism that has at least two genetically distinct cell lines, whereas most organisms only have one unique lineage of DNA in all of their cells. DNA is a molecule in an organism’s cells that contains the genetic instructions for the development and functioning of that organism. An organism that has two genetically distinct cell lines, then, has cells that contain genetic instructions for different types of organisms.

To create part-human entities or organisms, researchers often use embryonic stem cells as their source of human cells. Embryonic stem cells are cells taken from a human embryo at an early stage of development before they differentiate into, or become, more specific kinds of cells. During development, cells differentiate into specialized types, such as muscle cells or nerve cells, to take on specific jobs in the body. Because they are taken before they differentiate, embryonic stem cells are very versatile, as they have the potential to develop into many different types of cells. Scientific and medical researchers often use embryonic stem cells in experiments because they are easier to manipulate than differentiated adult cells. Experiments using stem cells are often regulated due to moral concerns, especially in the context of the part-human animal research Robert discusses. Robert’s article challenges the basis of some of those regulations.

At the time of the article’s publication in 2005, Robert was working as a professor in the School of Life Sciences at Arizona State University in Tempe, Arizona. He had completed his doctoral degree in the philosophy of biology at McMaster University in Hamilton, Ontario, in 2000. As of 2021, Robert holds the position of Director of the Lincoln Center for Applied Ethics, also at Arizona State University.

Robert divides his article “The Science and Ethics of Making Part-Human Animals in Stem Cell Biology,” into six sections. In his untitled introduction, Robert reviews the NAS’ guidelines on embryonic stem cell and part-human animal research and suggests that moral concerns about such research are often misplaced. In his second section, “What’s at Stake?,” he provides historical context for part-human animal and entity research by reviewing past experiments. In the next section, “Why Create Part-Human Animals?,” Robert outlines potential benefits of creating part-human animals for science and medicine. Then, he discusses the biological and ethical quandaries associ-

ated with creating part-human organisms in the following section, titled “Why Not?” Following that section, in “Justifying the Creation of Part-Human Animals,” Robert notes that there are different rationales for creating part-human animals or entities depending on the goals of different projects. In the final section, “Evaluating Research Proposals,” Robert raises concerns that the NAS guidelines might limit scientists from conducting important research, and makes some suggestions for how to balance scientific and ethical concerns in part-human animal research.

In the introduction, Robert reviews the 2005 NAS guidelines on stem cell and part-human animal research, and suggests that many moral objections to such research are poorly articulated. He states that the NAS published its guidelines to provide optional rules to govern human embryonic stem cell research. Robert indicates that the guidelines only prohibited a few activities, one of which was a restriction on combining human and nonhuman cells. Specifically, those guidelines prohibit the transfer of human embryonic stem cells into nonhuman primate blastocysts, which are structures at an early stage of fetal development, or the transfer of any kind of embryonic stem cells into human blastocysts. That meant that the NAS intended to restrict research on both chimera research and general research using human embryonic stem cells. However, Robert argues that the NAS did not present any compelling scientific or ethical reasons to support those restrictions, and expresses that he found other scholars’ justifications for those restrictions unconvincing. He finishes the section by asserting that researchers have deeply misunderstood the science and ethics behind creating part-human animals, and that he aims to explore the concerns about part-human animal research.

In Robert’s second section, “What’s at Stake?,” he reviews previous research in which scientists combined human and nonhuman cells to illustrate both the risks and benefits of such research. One example Robert provides is the late 1990s case where cell biologist Stuart Newman attempted to patent a technique combining human and primate cells. Newman unsuccessfully attempted to patent that technology to restrain scientists from conducting similar experiments until a public opinion could be agreed upon. Robert also describes numerous experiments involving the transplantation of human cells into a variety of animal fetuses, including monkeys, chickens, and sheep. While he acknowledges that such experiments may seem bizarre, Robert urges his audience to understand those experiments in a wider historical context of developmental biology, stating that researchers have been combining cells from different species as far back as 1969. Thus, he suggests that historically, chimera research has served purposes greater than merely creating the chimeras.

In the next section, “Why Create Part-Human Animals?,” Robert insists that part-human animal research can have important benefits for biological, and specifically medical, research. Robert states that experiments using part-human organisms may enable scientists to further understand how cells behave when they are transplanted, or moved from one part of the body to another, or even to another body altogether. Specifically, Robert suggests that scientists who use part-human animals may be able to better study how stem cells differentiate into their specialized cell types after being transplanted. For example, Robert mentions that transferring human stem cells into a nonhuman host may help scientists to predict more accurately the successes of human stem cell transplantation, such as bone marrow transplants, without actually having to experiment on humans.

In the same section, Robert also suggests that part-human animal research could create new sources of stem cells, tissues, and even organs that can have a variety of uses in research and medicine. Specifically, Robert mentions xenotransplantation, which is the transplantation of nonhuman cells, tissues, or organs into a human, or even the transplantation of human cells that have come into contact with nonhuman cells into a human. Robert states that researchers could transfer human stem cells into a nonhuman fetus, a stage of development after an embryo, so the fetus develops and creates a human organ from those cells that researchers could harvest and use for human transplantation. According to Zawn Villines, a medical writer at Medical News Today, organ transplants that replace damaged or failing organs can improve a person’s quality of life or even save a person’s life, but there are not enough organ donors to meet many patient’s needs. Having other sources of tissue or organs to use in such operations could therefore have the potential to save many people’s lives.

In the next section, “Why Not?,” Robert describes scientific and moral concerns other researchers have raised about the creation of human-nonhuman entities. One reason that some scientists oppose

part-human entity research is the possibility for zoonotic infections, or infectious diseases that spread between animals and humans such as Ebola, a viral hemorrhagic fever that passes between humans and other primates. However, Robert states that moral reasons against part-human animal research, such as concerns for human dignity, are often poorly articulated. He also highlights that researchers do not consider most of the part-human animal research that would have scientific value to be morally justifiable, while most of the morally justifiable research would have little scientific value. Robert posits that scientific literature has not yet addressed that tension between scientific and moral justification in part-human animal research.

Then, in "Justifying the Creation of Part-Human Animals," Robert states that the rationales for creating part-human entities change depending on the final use of the resulting entity. For example, if the final result is a humanlike cell or tissue culture, Robert asserts that scientists are more likely to support that than if the final result is intended to be used as a humanlike assay system, or a way to determine how a cell or process may happen in normal human development without the need for experimenting on early human embryos or fetuses Robert asserts that support is more likely to be garnered for a reason that could be helpful for potential medical advances rather than a less-obvious impact made by doing fundamental scientific studies. He also states that scientists should not take for granted the value of creating part-human animals, but that they will experience challenges justifying such research to the public.

In the final section, "Evaluating Research Proposals," Robert raises his concern that current guidelines on part-human animal and entity research might restrict scientists from conducting useful experiments, and urges that such research be ethically reviewed on a case-by-case basis rather than having rules restricting all part-human animal research. He argues that general rules on research that prioritize moral acceptability may inhibit researchers from conducting useful experiments. The best way to balance the needs of scientific usefulness and moral justifiability, he posits, is to review research projects individually. Robert suggests that Embryonic Stem Cell Research Oversight committees, or ESCRO committees, created by the NAS could be responsible for reviewing each experiment involving the use of human embryonic stem cells, including part-human animal research using those cells, under scientific, ethical, and political scrutiny. He suggests that reviews by such committees could help fulfill the need for ethical review while allowing scientists to have more freedom to conduct useful research. He also offers up that reviewing part-human animal research projects individually will also encourage scientists to better articulate their reasons for pursuing such projects, which could help alleviate public concerns of irresponsible or unethical science. He concludes by declaring that science will only move forward when it takes into account both moral concerns and scientific needs.

Following the publication of "The Science and Ethics of Making Part-Human Animals in Stem Cell Biology," Robert continued presenting and publishing articles on the ethics associated with chimera research and how scientists could justify such research. As of May 2021,"The Science and Ethics of Making Part-Human Animals in Stem Cell Biology" has been cited over fifty times, including one publication about the creation of a chimeric mouse with human cells to use as an assay system to determine the function of a human form of tumor in mice rather than in humans. "The Science and Ethics of Making Part-Human Animals in Stem Cell Biology" challenged guidelines on part-human animal research to give scientists more freedom to pursue research that Robert claims has the potential to be useful to science and medicine.

Sources

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