

Chimeraism thesis

Business



Chimeraism is rarely spoken of in everyday life, but is well studied in the world of science. A Chimera can be identified by a number of examples: HH (human-human) Chimeraism (surgically implanting pluripotent stem cells from another person, inside a patient), HNH (human-nonhuman) Chimeraism (putting human DNA in a mouse oocytes), and NHH (nonhuman-human) Chimeraism (human stem cells grown inside an animal and then implanted into a human patient).

The introduction of new and foreign stem cells into a patient will turn him/her into a chimera; one person with two genomes. The Chimera, in Greek mythology, is a fire-breathing female creature that worked havoc in the countryside near Lycia. It had the head of a lion, the body of a goat and tail of a snake. Chimera (also spelled Chimaera) was eventually killed by Bellerophon with the help of Pegasus.

One mythological version suggests the monster was born from the volcano of Chimera, near Phselis in Lycia. Lions lived at its peak, goats at the middle, and poisonous snakes at the bottom of the volcano. Another version suggests Chimera was born from Echidna, a creature that was half woman and half snake, and Typhon, son of the Titan Gaia. Though after a while, any abnormal or imaginary creature and, any oracular scheme was termed a chimera. In biology 'chimera' may be used for any hybrid, plant, or animal. In literature, we can also use 'chimera' metaphorically as an imaginary fear.

There are different types of Chimeraism, human, plant, and animal. Human Chimeraism, consists of things like blood transfusions and organ transplants. Plant Chimeraism, involves mixing the genes of different plants, grafting, etc.

Animal Chimeraism, is probably the most popular region of Chimeraism; involving the experimentation of mixing different species, and tissue grafting. Specifically, a chimera is a creature with DNA, cells, tissues, or organs from two or more individuals. If the tissue comes from more than one species, this produces an interspecific chimera.

Chimeras aren't produced through sexual reproduction, as hybrids are. For example, mules born from a male donkey and a female horse are hybrids, not chimeras. Intra-species Chimeraism, is the most reliable route to histocompatibility (having antigenic similarities so that cells/tissues transplanted from the donor to the recipient are not rejected) is most likely to be a combination of Chimeraism and cell banks. Preliminary findings show that stem cells that are injected into the bone marrow travel throughout the body, until finally lodging themselves in various organs. Keeping this in mind, in theory scientists could establish a bank of hES (human embryonic stem cells) lines. The line that is most like that of the patient's would be chosen, then a sample would be withdrawn from the bank.

Some of the stem cells would be injected into the patient's bone marrow, while the other stem cells ex vivo (the artificial environment outside the living organism), would be teased into specific tissues such as liver tissue. After two weeks, the new stem cells will have traveled throughout the body, some ending up in the liver. When the surgeon inserts the new liver tissue, the already present stem cells will accept them. We use the term 'chimera' because after the surgery, the patient would have two sets of genes, the genes he/she was born with and the ones recently transplanted. This theory

would result in a single person with two cooperating genotypes. This is what we call intra-species Chimeraism, not a form of mixing species.

Nonhuman animal genes wouldn't be introduced into a human through this method. Using SCNT (Somatic Cell Nuclear Transfer) to create chimeras, or a cross between species, is genetically distinct from a naturally occurring chimera. A problem with pursuing SCNT is that it needs a large source of human eggs, which are "hollowed out" for genetic implantation. Some are concerned that researchers will go around this problem by implanting human genetics into egg cells obtained from another species. There was a debate, for example, that the creation of HH chimeras by mixing cell lines from different embryos, may be a future route to gene therapy. An example would be genetic mutation; the cells of a person suffering from fibrosis don't produce enough structure needed to transport salt, causing the harmful accumulation of mucus throughout the body, especially in the lungs.

It might be possible in the future, to correct these problems by placing an embryo with one or more healthy cells. Chimeras aren't just created scientifically, some occur naturally too. Human or HH chimeras are unexpectedly created during fertilization. Two eggs will become fertilized, then fuse together becoming a single embryo. If that happens a person can be born with two genomes, such a person is a chimera. Some people grow old and die, never realizing their double genetic status.

In addition to natural chimeras, scientists can create them in hospitals and laboratories. Such as leukemia patients who receive blood stem cell transplants. Once the foreign stem cells have made their home, the patient

becomes chimeric. In attempts to institute histocompatibility for prospect organ tissue transplants, stem cell researchers are experimenting on creating chimeras. This is the theory: Doctors would first inject donated hematopoietic stem cells into the bone marrow.

After these have traveled throughout the body and stopped in the organs, doctors would surgically implant the stem cell—producing organ tissue, obtained from the same donation as the hematopoietic cells. The desire is that the previously joined blood stem cells will welcome the surgically implanted tissue without problem. If this works, HH Chimeraism will become a routine stem cell therapy. Although some chimeras are born naturally, most are created experimentally by mixing cells of early embryos or tissue grafting in late embryos or adults. Experimental chimeras are used to study many biological questions, including the origin and end of cell lineages during embryonic development, immunological self-tolerance, tumor susceptibility, and the temperament of malignancy. Experiments creating animal-human hybrid-embryos, which involve inserting human DNA into enucleated rabbit oocytes, have already been directed in China, up to the blastocyst stage.

Scientists have no knowledge where this and later interspecies experiments might lead. Though the creation of these chimeras, even in embryonic form, shows how able we seem to blur the boundary—biologically and morally—between human beings and animals. There are two techniques used to create chimeras from mixing embryo cells, they are aggregation and injection. Aggregation chimeras were the first experimental mammalian chimeras to be produced from mouse embryos in the early 1960s, first by <https://assignbuster.com/chimeraism-thesis/>

Andrei Tarkowski and later by Beatrice Mintz. The technique consists of removing the zonae pellucidae from 8-16 embryos cells of different strains of mice, and pushing them together so that the cells can aggregate.

After a short period of culture, the aggregate develops into a single large blastocyst, and the embryos are returned to a hormone-primed foster mother. Chimeric children are distinguished in several ways. Derived from the embryos of pigmented and albino strains, they may have strips of pigmented skin and patches of pigment in the eyes. Internal Chimeraism can be detected by using chromosomal markers or, genetically determined enzyme alternatives. Chimeras accept skin grafts from the two component strains but refuse grafts from third-party strains.

Aggregation chimeras formed from embryos of strains A and B are denoted A? B. Chimeras developed from two embryos are often called tetraparental animals. About 15 mice embryos have been aggregated to form a large single blastocyst. However, the children from such experiments are always normal, so the size regulation must happen after implantation. On average, 50% of all aggregation chimeras will be XX? XY.

Determining genders depends on the relative amount of XX and XY cells in the fetal gonads, in mice most of these animals develop into phenotypic males. The Injection chimeras technique, was first described for mice embryos by Richard Gardner in 1968. A blastocyst of the host mouse strain is removed from its zonae pellucidae and held on a suction pipette. The donor's strain cells are injected through a fine glass needle, into either the blastocyst cavity or the center of the inner cell mass (the group of cells taken from the

fetus). After a short time of culture, the blastocyst is returned to a foster mother. The analogy of aggregation chimeras, injection chimeras are denoted A? B and are recognized by similar, genetically determined markers (pigment formation, and enzyme, serum, and urinary protein alternatives).

Assortments of cells have been injected into blastocysts this way. Adult cells either fail to grow or become incorporated into the fetus. Embryos in the early-cleavage-stage are injected into the giant blastocysts cavity (formed by several aggregation embryos in culture as described above) develop inside their zonae into "blastocysts within blastocysts". In comparison, individual cells or groups of cells isolated from embryos (about the same age as the host) incorporated into the host embryo and grew, differentiating along with it. By taking accordingly marked cells from distinct positions in the donor embryo, and placing them in different positions in the host blastocyst, following their contributions to the late-gestation embryo or adult, has gained us important information about cell interactions and lineages in mouse development. Animals that have received skin and/or organ grafts are technically chimeras.

Radiation chimeras are created when an animal is exposed to x-rays, which kills the blood-forming stem cells in the bone marrow, and then are given a bone marrow transplant from a genetically different animal. Lymphoid cells, (in the process of transforming from stem cells in the donor marrow) distinguish the beneficiary as "self", and don't rebel against the host cells. By replacing the thymus from the illuminated host with one from another animal (prior to the bone marrow transplant), science has shown that this organ plays an important part in the creation of immunological self-

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tolerance. Naturally occurring chimeras (in humans) are quite rare, and are best recognized by their cells, reading XX and others XY. Such people are usually hermaphrodite, most likely because of fertilization of the egg by a single sperm and the second polar body by another, then both diploid cells adding to the embryo (the small polar bodies are normally deteriorated).

Blood chimeras are even popular in animals. Cattle for instance, where blood vessels in the placentas of twins fuse together, so that blood cells are able to pass from one maturing fetus to the other. The female of male and female cattle twins is sterile (a freemartin), because sexual hormones from the male fetus interfere with sexual differences in the female." Blood Chimeraism almost always occurs in marmosets, which produce twins in most pregnancies, surprisingly no flaws in sexual activities have been found. Let's clarify an issue with the following question: " If we take human stem cells and place them in the brain of another animal as a host, and if our stem cells affect not just the body but also the mind of that animal, then what?" A lot of smaller questions are compressed inside this larger one. For starters, do any moral issues emerge from mixing cells of different species? Would the effect (if any) on the animal's mind lead us to cross an ethical threshold? Just recently, a group of scientists and ethicists writing for Science magazine studied the ethical issues surrounding the transplantation of human neural stem cells into the brains of nonhuman primates (H-NHP).

This is how they suggested the questions: " If human neural stem cells were implanted into the brains of other primates what might this do to the mind of the recipient?" and, " Could we change the capacities of the engrafted animal in a way that leads us to re-examine its moral status?" These are <https://assignbuster.com/chimeraism-thesis/>

interesting questions. Here is a question that scares some of us: “ Should we mix the genes of two different species?” This is what the previously mentioned Science team said, “ We unanimously rejected ethical objections grounded on unnaturalness or crossing species boundaries.” There are two reasons that make this question easy to answer. One, a thing like boundaries between two species doesn’t exist, in a scientific sense. Yes, we’ve inherited from the Darwin era and earlier the approach that species are defined as “ a group of organisms that can reproduce.” If it’s not possible for you to make babies together, you belong to another species.

But because of new knowledge, that is not the case. Regarding the regularity of DNA, shows the thick lines separating the genetic differences of all living things are fading away. The prospect that there are fixed species boundaries is not well supported in science of philosophy. Moreover, human-nonhuman Chimeraism has already occurred through xenografting. Scientifically, all life belongs together.

DNA duration is the reason mixing genes is easy to do. Although science rejects with ease the problems affiliated with Chimeraism, many are still wary about the idea. A few religious bioethicists aim to prevent mixing species, thereby, shut down this type of hES research. For instance, in the prospect of Xenotransplantation (xenotransplantation mainly refers to NHH of HNH chimeras); the Pontifical Academy for life attempts to defend the human identity from Chimeraism. This could be interpreted as fixed rejection of Chimeraism, not a categorical ban. Now let us put our focus to the chimera debate: “ Mixing genes between humans and NHPs.

" I note that grafting stem cells into a human brain (for experimental purposes) is a " no-no". Hidden behind this " no-no", obviously, lies the dogma of human dignity. Appropriately, we treat each fellow human as an equal, adding nonhumans into this (experimental or not) is to most unethical. That is why scientists turn to experiment on nonhuman models, being that dignity becomes no problem. Or does it? To help us understand what's happening here, let's go back to the German philosopher, Immanuel Kant.

Kant provided us with ethical dignity that the Western world now takes as certain: " We must treat a person as an end and not merely as a mean toward some further end." But that's not what's relevant here. What is relevant, is when Kant figured out what a person is, the notion of rationality was proposed. A human is an animal with the ability to reason. There is something extraordinary about reason, very special.

The base of that principle is this: " Rational nature exists as an end in itself." Theologians previously and thereafter Kant have been surprisingly sympathetic to this. Kantians have expanded the meaning of mind, so to speak, in their quest for how humans have advanced in evolution. Opposable thumbs? Bigger brains? A more intricate brain? Lingual ability? Ample affiliations? Morals? Culture? Spirit? Because some primates have expressed some of these characteristics, we think of them as the closest animal to human beings. At what point do they stop being animals, and start becoming people with moral status and human dignity? Because of the way we think questions consulting brain cells will appear in the dilemma of such ethical deliberation.

Thus the Science ethics team's main question, asked by Ruth Faden et al.: "What might the implantation of human brain cells in a primate do to the animal's brain, and could this change the animal's moral status? If we place neuronal stem cells into the brain of a chimp or gorilla, might the animal develop a rational or immortal soul?" A reasonable outcome of H-NHP neural grafting is that the resulting creature will develop human like intellectual ability important to moral status. And if so, will we then need to give the animal all the rights that people can claim in our society? It is important to recognize that the evidence to date indicates that the risk of this happening is low, if nonexistent. The previous opening of placing neural progenitor cells into developing animal brains led to unification of the human cells; yet, no changes in animal behavior were reported. It seems that when hES cells are placed in primate brains, the host cells take over the direction of development. In botanical use, a chimera is a plant containing two or more genetically different cells.

Chimeras can be created by either mutating a cell in some part of the plant (where cells divide), or by bringing together two different plants so that their cells reproduce side by side to exhibit a single organism. They are studied not only because they are interesting, but also because they help us understand the developmental characteristics of plants, that would otherwise be very complicated to explore. The first type of chimera that was produced was the result of grafting. Seldom a bud forms at the intersection of the scion and stock, including cells from both plants. Sometimes cells arrange themselves so that shoots acquired from the bud will contain cells from both plants.

This kind of plan is called Labernum adami, formed in 1825 by grafting Cytisus purpureus onto Labernum anagyroidies. Instead of the flowers being purple or yellow, they are brown of the scion and stock. Its leaves resemble the Labernums except for the surfaces, which are like those of the Cytisus; and its seeds always grow into Labernum trees. Seldom does a branch grow out fully like a Labernum or, more uncommonly, like a Cytisus. At first people thought of the Labernum and other grafted plants to be nonsexual hybrids (the outcome of fusing together two somatic cells), but there was no indication that this could ever happen. The unusual reversion to pure Labernum or Cytisus branches and the future of their seeds weigh heavily against this theory.

Further analysis shows that the plant contained the skin of Cytisus cells and the core of Labernum cells. The plant's skin is only one cell deep, and its flowers look brown because of a purple epidermis that covers the yellow cells inside the petals. The germ cells that form the embryos in the seeds are always made from the second layer of the shoot, so they will always bear Labernum plants. Reversions happen because some buds that are formed entirely from the Cytisus skin or the Labernum tissue that bursts through the skin in bud configuration. Labernum adami has been synthesized only once, all of the samples in existence have been propagated from the original. This entails a lot of stability in the dogma of the chimera.

And it took a long time after the plant was created, for people to recognize any apparatus that could give a shoot such a stable variety of genetically distinct cells. As an attempt to solve this problem, Scientists discovered that flowering plants have growing points (apical meristems) where the external

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cells are organized in layers parallel to the surface. This periclinal layering is because of the external cells separate only anticlinally, by walls perpendicular to the external part of the growing point. In numerous plants there are two external (or tunica) layers and, because cell fragments are bound to the anticlinal planes from the underlying non-layered tissue called the corpus, each layer staying discrete from the other. The epidermis of the leaves, stems, and petals are derived from the external layer of the growing point, and the distinctness of this layer accounts for the endurance of the Laberocytisus chimera. Proof that these self-perpetuating layers exist in apical meristems, came with the synthesis of the polyploidy chimeras in *Datura* and *Vaccinium*.

This was accomplished by treating the embryos (or buds) with colchicines, a drug that causes nuclei to divide and double their chromosome number. Since these tetraploid cells and their progeny are bigger than that of ordinary diploid cells, they are identified in sections cut through the growing point. After the (treated) meristems had been allowed to grow and exerted lateral buds, the buds are sectioned it was shown that each tunica layer contained only cells with the same ploidy; but one layer of ten consisted of cells from a different ploidy of the other tunica layers and the corpus. The special anticlinal divisions of tunica layers evidently prevent mixing cells of different ploidy and stop the competition between cells, stopping the creation of an unstable chimera. A periclinal chimera has genetically different layers.

With this type of chimera, it's possible to pursue into the growing point through the stems, leaves, and flower tissues that come from the growing
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point. For leaves, this can also be achieved with variegated chimeras; the tracts of cells whose plastids lack this pigment seem white or yellow instead of green. A general form of variegated chimera has leaves with white margins and a green center. The white margin comes from the second tunica layer, and the green center from the inner cells of the growing point. The white leaf tissue overlaps the green in the center of the leaf, but doesn't mask the green color. Chimeras with green leaf margins and white centers are generally the outcome of a genetically green tunica multiplying unusually at the leaf margin which would otherwise be white.

Periclinal chimeras can be used to analyze the fate of the growing point's different regions, and how the leaves (and other parts of the plant) are constructed. But chimerical plants (seldom) don't behave like non-chimerical plants. Since somatic mutation admits that most variegated and polyploidy chimeras would generally occur in a single cell of a growing point or an embryo, what often happens is that the cells reproduce into a tract of mutated cells to create a section of the plant. If the mutation fails to create green pigment, the tract will be seen as a white stripe. These chimeras are called sectoral, but they are generally unstable because there is no apparatus to isolate the mutated sections and in the flux because of growing and dividing cells inside the meristem. Then one or two sorts of cells take over its self-perpetuating layer in the growing point.

Therefore, the sectoral chimera becomes non-chimeric or a periclinal chimera. Nevertheless, in one class of the chimera, a segregating apparatus is able to stabilize the sectoral arrangements. This reproduces stripes of mutated tissue into the shoot, but because the tunica and corpus are

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separated from each other, the plant is not fully sectioned and is therefore called a mericlinal chimera. Many chimeras like this have only one tunica layer with green and white stripes in the leaves. It wasn't until C.

Thielke tried to find the reason why these chimeras are stable, that attention was diverted to the fact that they are always plants with leaves in two ranks. And oddly enough, the lateral development of the growing point arises because of cell expansion only in the plane section connecting alternate leaves. The outcome is in the longitudinal sectional of the corpus cells, confined to planes at right angles to the section holding the leaves. A mutation in one cell can present a vertical sheet of mutated cells, which manifests itself as a white stripe in every future leaf, as the result of a plastid defect. Alternate sections throughout the bud affirm that the cells behave as predicted. The eversport is a special type of chimera that's generally found in gymnosperms, where a shoot becomes half green and half yellow.

An eversport comes from a periclinal chimera with a yellow tunica and a green corpus that will become yellow. This alteration was explained by H. Derman as coming from a "replacement" periclinal cell sections of the tunica's topmost cell, with one yellow daughter cell still in the tunica and the lower yellow daughter cell becoming part of the corpus. The new yellow corpus cell (and preexisting green corpus cells) reproduce into a half yellow and half green corpus, hence seen as a green-yellow chimera. Recent studies show that most eversporting green-yellow chimeras in gymnosperms and dicots, eventually turn all yellow, leading to the resolve that the apical meristem has one apical cell in the top tunica layer alike to what was found in mosses and ferns.

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Eversports have also been used to comprehend which region of the stem creates a leaf. The roots growing points may also become chimerical, but there is no apparatus to isolate genetically distinct tissues like you can in shoots, making it unstable. Nevertheless, there can be enough stability to carry out experiments with induced root chimeras on the fate of cells. Since the common acceptance that organisms with genetically diverse cells exist, many cultivated plants have also been found to be chimeras. This information has explained several puzzling phenomena.

In carnations, for instance, white flowers have appeared from the red variety being a periclinal white-red chimera whose general stability was disturbed. Color fragments of ten show the chimerical nature of such plants. Colors change in potato tubers similarly, because the plants are periclinal chimeras. In conclusion, Chimeraism is much more common than most people realize. It occurs not only in laboratories, but in mother nature as well. Though the moral implications are still greatly debated, the outcome of chimeric experimentations can have great benefits.

Chimeraism may someday help this worlds greater issues, such as healthcare and hunger.