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The Ethical Intersection of Biotechnology and Artistic Expression in Bio-Art

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ABSTRACT

*The intersection of **biology, technology, and artistic expression** has given rise to **bioart**, a field that challenges traditional notions of creativity and ethics. This study examines the **scientific, ethical, and societal dimensions** of bioart, exploring its implications for both artistic and scientific communities. Using a **qualitative approach**, data was collected through **virtual focus group discussions** involving 30 participants, including bioartists, bioethicists, genetic engineers, biomedical scientists, legal scholars, policymakers, and students, ranging in age from 16 to 56.*

*The thematic analysis revealed a **divergence in perspectives**, with some participants viewing bio-art as an **innovative frontier**, while others expressed **ethical concerns** regarding the manipulation of living organisms. Key themes identified include **moral considerations, public perception, environmental risks, commercialization, and the necessity for regulatory frameworks** to ensure responsible artistic and scientific practices.*

*The findings suggest that while bi-art has the potential to redefine artistic expression, its ethical implications necessitate **urgent regulatory oversight** to balance **innovation with integrity**. As bioart continues to evolve, it remains essential to establish **clear ethical boundaries** to guide its development and mitigate unintended consequences.*

Keywords: Art, Bioart, Modern Art, Technology, Ethics, Bioethics.

Introduction

The Ethical Intersection of Biotechnology and Artistic Expression in Bioart

Art isn't merely a subject of vivid strokes of colours on a canvas; It extends way beyond that. It lives, it breathes, and it evolves. It is a mirror to humanity’s boundless advances. But what to expect when the techniques of science become the expression in art?

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Creativity has long been our subtend into the frame of curiosity, a path where innovation thrives. Similarly, dissolving the boundaries between biology and art gives birth to the realm of Bioart (Eleni, 2021), where biological processes and artistry closely entwine. However, this fusion stands on an ethical intersection (el-Haque, T., & Rami, M. 2024 p.12). Van Rensselaer Potter coined the term 'bioethics' in 1971, defining it as interdisciplinary ethics that would incorporate humanity's commitment to the total ecosystem to address a particular set of issues and dilemmas that arise with the development of modern biotechnology (Vaage, 2016).

Bioart is a form of art in which artists work with various life (Radomska, M. 2017) forms ranging from humans and animals to organs, cells, and even bacteria (el-Haque, T., & Rami, M. 2024 p.12). They use biodegradable biomaterials such as live tissue, blood, genes, or viruses as their canvases(Joanna, 2014). Since these materials naturally decompose or even regenerate, they reduce the environmental impact compared to conventional art supplies that leave behind long-lasting environmental footprints. (Melkozernov, 2021)

The revolutionary domain of biotechnology provides the scientific foundation for Bioart, enabling artists to modify the DNA of bacteria, plants, or animals by introducing synthetic genes to an organism or transferring natural genetic material from one species to another, to create unique living beings (Kac, 2002). Moreover, techniques such as genetic engineering present a powerful pathway to introduce specific desired genes from any source into recipient cells, integrating it directly into the organism's genome (Snow, 2005). Likewise, these genes can be introduced via methods like particle bombardment (e.g., Brettschneider et al. 1997), electrical (electroporation), physical techniques like silicon fibers, microinjection, or chemical methods using polyethylene glycol. Once fused, the cells and tissues are then grown through specialized processes like cloning, to produce whole organisms.

It is not just the combination of biology and art that gives rise to Bioart. Rather, it emerges from the collaboration of multiple disciplines. These include fields such as social and environmental science, technology, ethics, philosophy, and history. Amongst these, ethics extend into various subfields within Bioart. An apt instance is medical ethics, which is an applied branch of ethics, which becomes vital when it comes to unique and proactive cases such as the occurrence of Stelarc. An Australian performing artist who pushed boundaries of creativity and ethical parameters by implanting a third ear on his forearm (Avram), sliding a sculpture inside his stomach using video endoscopy equipment and a stomach pump, subtending his bare body in midair using hooks, and even attaching a "third arm" to his body to replace his right hand (Paolo and Woolford, 1995). Henceforth, these debatable performances highlight the importance of medical ethics as it encompasses manifolds of metaphysical considerations and practical concerns (Dunn,2018). Particularly concerning matters of consent, privacy, and the dignity of

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individuals involved to provide a balanced and systematic framework to analyze a wide range of such controversial topics (Robert M. Veatch, 2010).

history too, is incorporated to shape Bioart (Haraway, 2020).It respects Indigenous knowledge systems, such as the long-standing tradition of Indigenous people using animal blood to create artwork on cave walls, commonly referred to as Rock Art. These artworks were an essential constituent in ceremonial rituals, reflecting deep-rooted cultural significance (Eliade, 1959; Morris and Staikidis, 2023). Therefore, this intersectionality not only challenges conventional art but also raises thought-provoking questions regarding the depth of humanity's link to life and existentialism (Kac, Genesis), blurring the lines between the raw and the synthesized inviting reflection on the essence of creativity itself. In this vast expanse of artistic expression, Bioart emerges as a beacon, encouraging us to reassess our assumptions and reinvent the fundamentals of the core of creativity (Kac,2007).

It has been proclaimed by Myers (2015) and Yetisen et al. (2015) that, with the anticipated boom in this industry, an increasing number of artists will be working in laboratory environments in the years to come. Consequently, a clear and comprehensive ethical framework is urgently needed to be engineered to address the complex paradoxical dilemmas Bioart presents.

This study aims to gauge public perception by investigating the ethical boundaries in the context of Bioart by stimulating engagement between science and society to bridge the prevalent gap and exemplify how Bioart uses technology as a medium of both expression and creativity.

Procedure

This study aimed to understand public and professional views on the critical and ethical dilemmas raised by Bioart and epitomize how it uses technology as a medium of both expression and creativity. Despite the growing influence of Bioart, there is no universally accepted ethical framework governing its practice hence this topic was chosen to understand differing perspectives and form a preliminary structured ethical framework that balances scientific intervention with moral responsibility. This study employed focus group discussion to review public stance. The participants in the focus group were from diverse backgrounds which included 30. These included Bioartists, bioethicists, biotechnologists, genetic engineers, biomedical engineers, medical ethicists, synthetic biologists, legal scholars, policymakers, environmental scientists, bio-innovators, interdisciplinary researchers, high school students, professors, and teachers. All the participants were asked questions related to consent, sustainability, legal implications, artistic freedom, future concerns, commercialization, and intent in Bioart. Subsequently, the discussion and findings were transcribed and analyzed by forming coding tables and thematic tables.

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Result Table

Participant Quote	Code/ Sub Theme	Theme
"Conducting Bioart on animals may be very scary." "Also makes me concerned about what are its limitations and where and when to put boundaries on it" "When I first heard about DNA editing or all of this, I was a little surprised. I was like, what? Even this could happen" "This topic excites me because it, makes everyone think what we can achieve through the means of art and bio alone" "It is a little concerning but it is also exciting" "It's definitely a bit concerning. We have seen movies like X Men and also here things can go very bad also"	Initial reaction	Fascination
"But then wouldn't art just be playing the role of God? creating animals for them to be admired. Life would be admired like half face half word. It exists but what for?" "So that is why Bioart needs restrictions, right? "	Playing god	morals
"Unless its an in a contained manner it can yield catastrophic effects on the environment" "There is the problem of bioinvasion also" "But later on that same gene may be yielded at, lets say a different chemical or biological expression in a different Organism." "We do not know which gene is getting manipulated and where it is getting hidden. So the real problem may hide somewhere and it may come out at some other time." "Having done genetic engineering for a long time, you its not so precise at the moment and it can go wrong"	Fear of uncertainties	environmental risk
"It is us humans who have created a lot of chaos, so we only, it is only us who will have to act like a catalyst in the actual survival of organisms because it is very essential for them to adapt and adaptation as a process, it takes a lot of time, a lot of years, decades. But if we interfere in their natural process, it will obviously speeding it up and it will actually help them only"	Bioart for adaptation	Ethical justification
"Modify dogs to have less coat or we could modify plants to survive in harsh climates while making them look aesthetically pleasing"	Help plants and animals	Ethical justification

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“Exactly. I agree with Rishabh until and unless its an external change its OK, but an internal genetic change could harm a lot of them”	exception	Ethical justification
“We just make our voices and the rules are decided by the government or authorities.” “It should be approved by some other experts to ensure that nobody has a free hand to do whatever they wish to do” “The government should be the one making the laws, whether its ethical or not or it should be up to the majority.” “I would say, you need to access them from a certain committee and you need to state what you are going to do with them, how they are going to be used and the committee decides whether your actions are correct or not.”	Who is to enforce	Ethical framework
"So there is the problem of bioinvasion also." "So we know horizontal gene transfer exists in microbes such as bacteria. So this transfer of genes around the system is possible." "Might disturb the food chain and the pyramid we studied in lower classes."	Invasive species	environmental risk
"I think 50 years down the line, we will not solely rely on entertainment purposes or educational purposes because until then we would have figured out a way to bring the cost down in a very significant manner." "So much so that we would be able to conduct this experiment on a very large scale. And it could be that we start using this method on humans as well for curbing diseases, curbing genetic disorders and actually making life spans longer." "Likewise, even I would be very fascinated, but even I would end up questioning the actual deeper meaning of life and what we are doing as a humankind" "Bioart is not that would not be that different from the conventional art that we see"	Role of Bioart in society	Future of Bioart

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"But I think again the core essence of Bioart is not to harm the living beings, its to produce more creative aspects of it." “Ethics depends upon what is the ultimate goal of that experiment.” "I believe that art already holds the power of making anything beautiful or appealing to the eye and it has a deeper meaning" "The core essence of Bioart is not to harm the living beings, its to produce more creative aspects of it"	Intent behind art	ethics
"I don't think we can actually restrict ourselves from interfering in human lives as an aggregate because to progress to evolute as a mankind, we will have to experiment. But I think we can set some standards and some ethics that would define this better." "No, there should be some limitations and some restrictions in exploring art" "Like Lobotomy was one very famous scientific method to treat mental illness. But was that ethically and morally strong? Of course not" "We will have to keep in mind that there should be some restrictions or we do not create some morally weak structure that we follow in Bioart" "I think we can set some standards and some ethics that would define this better" “I would say that we should have stricter policies regarding the use of animals in non research scenarios ” “I appreciate the concern regarding the animals, but you can’t simply blame the researcher or the scientist for this. All these things are done only for the welfare of human society as well as for research purposes. If we think like this, then will we never conduct research?” "If we have to differentiate, there has to be a certain line that differentiates plants and certain organisms"	Need for policies	Ethical framework

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"We would have figured out a way to bring the cost down in a very significant manner" "Chicks and before they are born in their eggs are injected with some colourful compounds so that when the chicks are born they have colourful, unnaturally colourful just such as green, blue, deep red, orange feathers. But when they grow up they in human terms tend to be ugly. So what people do is that after the chick has transitioned into a somewhat mature state they throw the chicken away." "Bioart is expensive and requires a lot of patience. So, I cannot justify doing this just for entertainment purposes."	Selling Bioart creatures	Commercialization
"And we already are falling short of animals like from the last 2 to 3 decades there have been rising numbers of endangered species and extinct species." "This genetic manipulation in plants though it may appear it is not having any concern but that directly but ultimately it will affect us as animals also."	Effects on evolution and ecosystems	environmental risk
"Plants may be not mobile. So if something is going bad, maybe you can just you know, burn down everything or controlling is easier" "Unless its an in its in an contained manner it it can yield catastrophic effects"	Control and safety	Environmental risks
"The generation which we are in today and upcoming generation, they won't think twice but everybody would want to visit an exhibition that includes living, modified organisms" "I would be very fascinated, but even I would end up questioning the actual deeper meaning of life and what we are doing as a humankind." "Everyone would be fascinated to go and see animals which were extinct"	Exhibition of gm animals	Future of Bioart
"I would not support it completely because you already have a liberty to do it with the plants or something else. But why do it at the expense of a living being?" "No, there should be some limitations and some restrictions in exploring art " "We should not be crossing the line of intervening with their internal genetic structure"	opinions	Morals

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"We should have concern with genetic manipulation in plants also" "And even if these more difficult creatures are created, what is the possibility they could survive in the ecological conditions we have right now?" "What if we create an Organism that only feeds on humans?" "European pugs where their snout is too short to allow them to breathe for our artistic purposes."		

Discussions and finding

Aim of the study

The goal of this study is to analyze the views of the general public and professionals, scouring deeper into the ethical, artistic, and societal aspects of Bioart and how it incorporates technology as a medium of both artistic and scientific expression.

Method used

This study used the means of virtual focus group discussions to review public and professional stances. The participants in the virtual focus group discussion were from diverse backgrounds and were selected randomly. Furthermore, they were asked questions about consent, sustainability, legal implications, artistic freedom, future concerns, commercialization, and intent in Bioart. Subsequently, the discussion and findings were transcribed and analyzed by forming coding tables and thematic tables.

Ethical Concerns & Regulation

One of the most prominent discussions in the focus group discussion was about the ethical framework and the well-being of animals used (Ormandy Et al., 2011), where the majority of participants expressed concerns (Zylinska, J. 2014) about the moral implications of modifying living beings and demanded stricter regulations (Gibas 2019) concerning Bioart.((Bryant, T.L. 2009))

"We should have stricter policies regarding the use of animals in non-research scenarios"

"Conducting Bioart on animals may be very scary"

This discussion naturally led to concerns about the ethical and philosophical implications of Bioart. Many participants expressed the belief that altering living organisms purely for artistic

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purposes equates to 'playing God'(Pędrak, 2022), raising questions about the limits of human intervention in nature (Aus der Au, 2013).Some viewed this as a scientific and artistic overreach while some accepted humanities advancements and saw it as an inevitable side effect of development and progression.

"But then wouldn't art just be playing the role of God? creating animals for them to be admired.?"

"So that is why Bioart needs restrictions, right? "

Furthermore, this was followed by a brief discussion upon who is to enforce these policies (singh et.al 2023) and ethical boundaries (N.A.P. , 2019) . Some participants felt that regulation should be left to the government (Montgomery, J 2016), some felt it should be up to the public and the majority (Nielsen Et al.,2021), while the majority suggested that independent ethical committees should be the ones to oversee Bioart projects to prevent any misuse.

"It should be approved by experts to ensure that nobody has a free hand to do whatever they wish to do." -Bioinnovator

However, some participants argued that excessive regulation might stifle innovation and limit the creative and scientific potential of Bioart.

Hierarchical Differences: Plants vs. Animals

A notable theme in the discussions was the hierarchical contrast between plants and animals in the context of Bioart. Most participants demonstrated a clear ethical distinction between plants and animals in Bioart. While they largely accepted genetic modification in (kac,2005 p.244) plants (Lynas, 2018), they voiced significant ethical concerns when it came to altering animals due to their complex biological systems, which means even small genetic changes can have unpredictable physiological and behavioral effects.(Nussbaum, 2007)

Even Though a majority of participants viewed Bioart on plants as more acceptable than on animals, few raised concerns about the risk (Sanvido, 2007) of introducing genetically modified (tsatsakis Et al,2017) plants into the wild (Noack Et al,2024) by citing the example of BT cotton in India (Kranthi, 2020) and its adverse effects on health and ecology.

"This genetic manipulation in plants though it may appear it is not having any concern but that directly but ultimately it will affect us as animals also."

Environmental Risks & Bioinvasion

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Additionally, there was a discussion on environmental (Houdebine, 2014) risks(Caradus, 2022) associated with working with Hybrid or transgenic animals (Lopatkina, 2022) particularly when there could be possible uncertainties (Elgheryeni, 2021) and the unpredictability of genetic modification(snow, 2005) and the threat of bioinvasion (Liebhold, 2017) if genetically modified organisms were introduced (Keijzer, 2017) into the wild.

"There is the problem of bioinvasion also"

"Unless it's in a contained manner, it can yield catastrophic effects on the environment" - scientist

However, some participants considered a few instances where Bioart may be justified for environmental adaptation (cite) or even be helpful (Sousa, 2023) such as modifying huskies for Rajasthan's climate where temperatures soar around 50° (Press Trust of India, 2024), while still having them look aesthetically pleasing.

"Modify dogs to have less coat or we could modify plants to survive in harsh climates while making them look aesthetically pleasing"

Commercialization & Monetization of Bioart

Participants hypothesized on the future role of Bioart, with many concluding that the costs would decrease and techniques would improve in the years to come. Also, Bioart would move beyond artistic to maybe educational and help genetic disease prevention and life extension.

"I think 50 years down the line, we will not solely rely on Bioart for entertainment purposes or education. We would have figured out a way to bring the cost down and conduct these experiments on a very large scale."

Future Implications of Bioart

Some participants speculated that Bioart would be monetized in the coming years, in terms of selling genetically modified creatures that are visually appealing. Participants debated about the potential of the new market it might introduce while others questioned the ethical concerns behind commercialising Bioart.

"Bioart is expensive and requires a lot of patience. So, I cannot justify doing this just for entertainment purposes."

Bioart has the potential to expand beyond its conventional role in artistic expression by expanding into other domains such as the bio-medical and commercial sectors. As we progress with Bioart, we as a society need to redefine what constitutes art and ethical creation because

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future Bioart projects may include more complex beings in practice. This progression calls for future research to question the rights and ethical protections of bio-engineered beings. Researchers in the future will need to explore the ethical implications of using living beings for entertainment or aesthetic purposes and inquire about our current understanding of the value of life and creativity.

Besides, as Bioart moves towards commercialization, the potential for exploitation and harm must be addressed by future researchers. Furthermore, future research should also encompass policies that balance scientific intervention with moral responsibility which address and protect both the Bioart entities and even the environment around them.

Conclusion

The focus group discussion fostered diverse perspectives on the ethical and artistic possibilities of Bioart. Participants insisted on the need for an ethical framework to be introduced in order to balance scientific progress, environmental responsibility, and moral considerations. While the minority stated that excessive regulations could hinder innovation, the majority supported and argued for the need to establish independent ethical committees for supervision.

Naturally, it also revealed a clear boundary that separates animals from plants concerning Bioart. This discussion further suggested that future Bioart regulations may need to be altered to suit the distinction between plants and animals.

Participants were relieved by the fact that genetic engineering is complicated and expensive, which limits its use to experts and professionals only. However, there was a mention of worry that as biotechnology and genetic modification become more accessible and cheaper, more people could experiment in the future without proper control and inspection which they feared would lead to dangerous creations and unpredictable projects.

"What if we create an Organism that only feeds on humans?"

Even though Bioart holds promise to redefine our understanding of artistic expression, it must be guided by a strict ethical framework to ensure creativity does not come at the cost of integrity. Hence, justifying the stress upon the need for an urgent regulatory framework, especially for artistic expression to ensure safe innovation and prevent anomalies and adversity.

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