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REVIEW ARTICLE

EMOTIONALITY IS NOT SCIENCE: THE CASE OF BIOLOGICAL SCIENCES

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ABSTRACT

The integration of emotional reasoning into scientific discourse, particularly within biological sciences, poses significant challenges to the objectivity and empirical rigor essential for advancing knowledge and informing policy. This article explores how emotionality- rooted in personal biases, cultural and ethical concerns, and cognitive distortions- interferes with bio-scientific method, which relies on systematic observation, experimentation, and data validation to establish objective truths. Biological sciences, encompassing fields like genetics, microbiology, biotechnology, biochemistry, biomedicine, evolutionary biology among many others, frequently address ethically charged topics such as genetic modification, animal experimentation, climate change, and artificial insemination, making them susceptible to emotional resistance. This resistance often manifests as public misconceptions, regulatory overreach, and cognitive biases, undermining evidence -based decision making. Through case studies, this article illustrates how emotional appeals overshadow empirical evidence such as persistence opposition to genetically modified organisms despite robust safety data, emotive backlash facing animal experimentation and artificial insemination in both animal and humans, and climate change denial and vaccine hesitancy reflecting economic fears and misinformation amplified by media sensationalism. Furthermore, the regulation of biological processes and products reveals how emotional influences usually termed "yuck factor" or naturalistic fallacy can delay innovation and skew policies away from scientific consensus. To bridge the gap between emotions and evidence-based biological sciences, strategies including transparent science communication, public education, ethical frameworks that balance moral concerns with empirical realities, and risk-benefit analyses in policymaking were proposed. By distinguishing emotional reasoning from empirical evidence, this study underscores the necessity of safeguarding biological sciences from subjective interference to maximize societal benefits while addressing legitimate ethical considerations.

KEYWORDS

Empirical evidence, Emotional reasoning, Cognitive biases, Bio-sciences regulation, Risk-benefit analyses

1. INTRODUCTION

The use of scientific method was designed to eliminate personal biases and establish objective truths through empirical validation. However, as science continues to inform policies and challenge long-standing beliefs, it frequently encounters resistance fueled by emotional reasoning rather than rational deliberation. Biological sciences, in particular, often deal with deeply personal and ethically charged topics such as genetic modifications, human origins, disease research, and ecological sustainability. Consequently, public perception of biological discoveries is often shaped not by scientific rigor but by intuitive responses, moralistic concerns, and cognitive biases.

In the modern era of scientific discoveries, biological sciences have emerged as a critical field with significant implications for health, food and nutrition, environment, agriculture, as well as technology. They focus on understanding life processes at various levels, from molecular biology to ecosystems. This field encompasses disciplines such as genetics, microbiology, physiology, evolutionary biology, molecular biology, immunology, and ecology amongst others, all of which rely on empirical data, experimental validation, and objective observation (Campbell and Reece, 2017). While biological sciences employ scientific methodologies to study organisms, their functions, and their interaction with environment and also provide insights into physiological mechanisms underlying emotions - such as the role of neurotransmitters, hormones, and neural circuits- they do not engage with emotions in the way psychology, philosophy, or the humanities do, such as personal, cognitive and social experiences (Tyng et al., 2017). Biological sciences focus on measurable, reproducible phenomena that can be tested and validated.

The phrase "emotionality is not science" explains the relevance of maintaining objectivity in science research, formulation of policies and decision-making, as it is expected that emotions should not and must not interfere with scientific process. This article explores how emotional bias can undermine scientific progress in biological sciences, examining its impact and presenting case studies where emotional reasoning has interfered with scientific understanding and policy-making. The article also explores strategies to reinforce scientific literacy, emphasizing the necessity of distinguishing between emotional concerns and empirical realities.

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2. Empirical Evidence Vs Emotional Reasoning

Empirical evidence and emotional reasoning represent two fundamentally different approaches to understanding reality. In the context of biological sciences, empirical evidence is the foundation upon which scientific knowledge is built, while emotional reasoning is associated with subjective interpretations influenced by personal feelings, biases, and social influences. Biological sciences, as a natural science, rely strictly on empirical methods - observation, experimentation, and data-driven analysis- to uncover truths about living organisms and their processes (Campbell and Reece, 2017). In contrast, emotional reasoning is often employed in fields such as psychology, philosophy, and the humanities, where personal experiences and interpretations shape understanding.

2.1 The Role of Empirical Evidence in Biological Science

Empirical evidence refers to verifiable data collected through systematic observation, controlled experimentation, and replication of results. This approach ensures objectivity, allowing scientists to draw conclusions based on measurable and reproducible findings rather than subjective opinions or beliefs (Alberts et al., 2014). For instance, discoveries in genetics such as structure of DNA by Watson and Crick, were based on empirical data obtained through X-ray crystallography and biochemical experiments (Watson and Crick, 1953). Similarly, advances in immunology, microbiology and neurobiology depend on rigorous experimentation, statistical analysis, and peer-reviewed research to ensure accuracy and reliability.

One of the key characteristics of empirical evidence is its falsifiability, a concept introduced by Karl Popper (Mitra, 2020). Scientific claims must be testable and capable of being disproven through further experimentation. In biological research, hypotheses undergo extensive testing before they are accepted as scientific theories, as seen in the development of evolutionary theory and molecular biology (NAS-US, 1999). The reliance on empirical evidence safeguards scientific inquiry from biases and ensures that conclusions are grounded in reality rather than speculations.

2.2 Emotional Reasoning and Its Limitations

Emotional reasoning on the other hand, involves drawing conclusions based on personal feelings rather than objective evidence. This type of reasoning is common in everyday decision-making and social interactions but is not a reliable method for scientific inquiry. Emotional reasoning can lead to cognitive biases, such as confirmation bias (seeking information that aligns with one's belief) and the availability heuristic (overestimating the importance of recent or emotionally charged events) (Beck et al., 2019).

In deliberations about biological science researches, emotional reasoning can sometimes lead to misconceptions and resistance to scientific findings. For instance, debates around vaccination and climate change often involve individuals dismissing empirical evidence in favour of personal beliefs or emotions (Dopson, 2022). Although emotions are acknowledged to have played essential roles in human experiences, but they are not substitutes for scientific methods when determining objective biological truths are involved.

3. Influence Of Emotionality In Scientific Reasoning

Emotions are considered integral to human experience and ethical considerations as they can distort scientific interpretation when they override critical analysis and empirical scrutiny. It is based on this that emotional reasoning tends to accept or reject information based on how it aligns with personal feelings rather than objective evidence. Cognitive biases and emotional interference can seriously influence the interpretation of data, decision-making in research, and public perception of bio-scientific findings. While biological sciences aim for objectivity, researchers, policymakers, regulators, and the general public are not immune to biases and emotional reasoning, which can impact how scientific knowledge is generated, disseminated, and accepted (Beck et al., 2019).

4. Cognitive Biases In Biological Sciences

Cognitive biases are systematic errors in thinking that affect judgement and decision making. In biological sciences, these biases can lead to misinterpretation of data, flawed experimental designs, and resistance to paradigm shifts in scientific thought (Kahneman, 2012). Key biases include:

4.1 Confirmation bias

Confirmation bias occurs when key research stakeholders including the public selectively seek, interpret, or remember information that supports their existing beliefs while ignoring contradictory evidence (Kahneman, 2012). This bias can be particularly problematic in experimental biology, where researchers may unconsciously favour data that aligns with their hypothesis. For instance, in early genetic studies, scientists initially resisted the idea of non-coding "junk" DNA having functional roles, as it contradicted the prevailing gene-centric view of biology (Fagundes et al., 2022).

4.2 Anchoring bias

Anchoring bias occurs when scientists and the interested public place too much weight on initial findings or pre-existing theories, making them resistant to new evidence. This bias was evident in the early resistance to the concept of horizontal gene transfer, where scientists initially adhered strictly to the idea that genes are passed only from parent to offspring (Michaelis and Grohmann, 2023; Koonin, 2016). Over time, empirical evidence from bacterial genetics and evolutionary studies forced a paradigm shift, demonstrating that genes can move between organisms in non-traditional ways.

4.3 Publication bias

Publication bias is the tendency of journals to favour publishing studies significant of positive results over those with negative or inconclusive findings (loannidis, 2005). This skews the scientific literature, making certain hypotheses appear stronger than they actually are. In biomedical research for instance, clinical trial with favourable drug outcomes are more likely to be published than those showing no effect, potentially misleading healthcare professionals and patients (Dwan et al., 2013).

4.4 Observer bias

In biological experiments, particularly those involving qualitative assessments, observer bias can influence results when researchers unintentionally perceive data in a way that confirms their expectations, leading to skewed results. Implementing double-blind experimental designs can help mitigate this bias (Pinto, 2023).

In contributing to the intrusion of emotions into bio-scientific discourse, other several cognitive biases that create barriers to objective understanding, fostering resistance to bio-scientific advancements include:

Table 1: Other Cognitive Biases in Biological Sciences

	Cognitive Biases	Meaning	Impact in biological sciences	Example	Reference
i	Affect Heuristic	Occurs when people rely on their emotions, rather than logical analysis, to make decisions. Within a scientific concept, a positive or negative emotional association can influence risk perception.	People may reject a biotechnology such as synthetic biology just because it feels "unnatural" or "risk", despite objective evidence showing its benefits and safety. Also negative emotional reactions to terms like "cloning" or "gene-editing" may override scientific understanding	Anti-GMO activists usual use of the term "Frankenfood" triggers negative effect, which biases public perception against genetically modified foods	Slovic et al., (2007). Esquivel et al., (2023).

Table 1(Cont.): Other Cognitive Biases in Biological Sciences					
ii	Status Quo Bias	The preference for the current state of affairs and resistance to change. Innovations in biological sciences often face skepticism due to the fact that they challenge traditional norms.	People may oppose new health technologies, preferring conventional treatments or agricultural practices even when newer methods are more effective and safe. Furthermore, policy makers may delay the adoption of novel regulatory frameworks due to resistance to systemic change.	Situations where farmers may reject advanced agricultural technologies in favor of traditional methods, even when data supports improved yields and sustainability	Samuelson and Zeckhauser (1988), Hofman et al., (2022)
iii	Omission Bias	Tendency to judge harmful actions as worse than equally harmful inactions. In bioscientific contexts, people often prefer not to intervene- even if intervention could prevent harm- because action seems riskier.	Individuals may resist gene therapy or vaccines because administering them feels like a risky action, whereas doing nothing (even if more harmful) feels morally safer Also regulatory authorities may avoid approving controversial biotechnologies to avoid being blamed for hypothetical future harm.	Individuals may refuse vaccination due to the fear of side effects, despite the higher risk of the disease without vaccination.	Ritov and Baron (1990). Clarke et al., (2017).
iv	Dunning-Kruger Effect	Cognitive bias in which individuals with low expertise overestimate their knowledge and make confident-but incorrect-judgements. It is particularly harmful in debates about complex biological sciences topics.	Non-experts may loudly oppose bio-scientific advancements while believing they understand the science better than trained researchers and scientists. The social media amplifies such voices, leading to widespread misinformation and public doubt.	Social media influencers promoting anti-vaccine content by misrepresenting basic immunology, leading to real-world vaccine hesistancy.	Kruger and Dunning (1999). Osborne and Allchin (2024).
v	Availability Heuristic	Tendency to judge the likelihood or frequency of an event on how easily examples come to mind. Emotional stories such as genetic modification controversies, genome editing controversies and adverse vaccine reactions are widely reported, they dominate public perception- regardless of how rare such incidents actually are.	Individuals may oppose biotechnology or pharmaceuticals because of one high-profile adverse event, even when empirical data show the benefits far outweigh the risks. Media coverage of a single genetically modified food scare can generate widespread fear, despite decades of safety assessments.	Fear of CRISPR gene-editing spiked after controversial “CRISPR babies” incident in China, even though the majority of gene-editing research is tightly regulated and focused on therapeutic and agricultural applications.	Tversky and Kahneman (1973). Lovell-Badge (2019).
vi	Framing Effect	The influence of how information is presented. The same bio-scientific fact can provoke different reactions depending on whether it is framed positively or negatively.	Risk communication strategies can either reassure or alarm the public depending on word choices. Technologies like gene-editing may be more accepted if framed as “curing genetic diseases” versus “altering the human genome”.	“95% survival rate vs 5% mortality rate” for a treatment elicits significantly different public reactions, though statistically equivalent.	Tversky and Kahneman (1981). Hooker et al., (2017).
vii	Hindsight Bias	This occurs when people believe, after an event has occurred, that they could have predicted the outcome. This can distort assessments of bio-scientific decision-making under uncertainty.	Public may unfairly criticize scientists for unpredictable outcomes or side effects, undermining trust in future innovations. Even regulators may become excessively cautious in approving new technologies due to fear of retrospective blame.	Criticism of early COVID-19 research and policy decisions, even though choices were made with limited data at the time.	Roese and Vohs (2012). Ash et al., (2023).

Table 1(Cont.): Other Cognitive Biases in Biological Sciences					
viii	Negativity Bias	The tendency to give more weight to negative information than to positive or neutral information. In biological science communication, even minor negative findings can disproportionately influence public perception	A single negative study or adverse event can erase trust built through decades of positive outcomes. Public discourse becomes dominated by worst-case scenarios rather than balanced evidence.	Wide spread fear of gene therapy after early trials resulted in patient deaths, overshadowing numerous successful applications that followed.	Baumeister et al., (2001). Hoh (2023).

5. Emotional Interference In Bio-Scientific Research

Emotion, while integral to human experience, can interfere with the objectivity required in scientific research. Emotional attachments to theories, personal beliefs, or societal pressures can cloud judgement and influence the conduct of research, the interpretation of the findings and acceptability of the findings.

5.1 Ethical and moral biases in bio-scientific research interpretation

Biological sciences research areas like genetic modification and stem cell therapy often evoke strong emotional responses, influencing both the scientific inquiry and public policy. Emotional concerns about moral implications of such research can lead to restrictive regulations, potentially hindering scientific advancements. Therefore, balancing ethical considerations with empirical evidence is essential for informed decision-making.

5.2 Emotional resistance to paradigm shifts in biological sciences

Over the years, groundbreaking bio-scientific theories have often faced emotional resistance due to their challenge to established beliefs. One major resistance was the initial rejection of the bacterial cause of peptic ulcers illustrating how prevailing medical assumptions can impede acceptance of new ideas (Radomski et al., 2021). Overcoming such resistance requires openness to new evidence and a willingness to revise existing paradigms.

5.3 Misinformation and fear in public perception

Historically, public reactions to scientific developments are frequently driven by emotions rather than scientifically proven evidence. A good example is the vaccine hesitancy which has been fueled by fear and misinformation, despite robust empirical support for vaccine safety and efficacy (De Figueiredo et al., 2020). Addressing these challenges necessitates effective science communication and public education to align perceptions with scientific realities.

6. Case Studies Of Influence Of Emotions To Scientific Evidence In Biology

The history of biology is rich with cases where emotional resistance delayed scientific breakthroughs. Charles Darwin's theory of evolution, which has become the cornerstone of modern biology, faced intense opposition from religious and social groups who viewed the theory as threat to human exceptionalism (Numbers, 2006). The debates was not about evidence but dwelt more on emotional discomfort and religious sentiments with the implication of evolution.

6.1 Genetic Engineering and the Fear of the Unknown

The achievements of genetically modified organisms (GMOs) in agricultural, environmental and medical science cannot be overemphasized, and these have offered solutions to food security, disease resistance, and improvement in crop yield. However, despite extensive scientifically based assessment and research confirming their safety, opposition to GMOs persists, driven largely by emotional appeals rather than scientific critique (NASEM, 2016).

Anti-GMOs movement often invoke fears of "tampering with nature" of "corporate control of food", employing emotionally charged language rather than engaging with extensive body of evidence supporting the safety of genetic modifications. Misinformation campaigns, fueled by social-media and activism, have contributed to policy decisions that restrict safe and responsible GMO research and usage in various countries, despite the absence of empirical risks (Blancke et al., 2015). A study, showed the correlation between basic emotions and the acceptance of GMOs with anger, fear, disgust and contempt as significantly linked to the rejection of GMOs while interest and surprise as positive emotions are frequently elicited but do not necessarily correlate the acceptance (Sorgo et al., 2012).

6.2 Ethical Dilemma of Animal Experimentation

Animal models have long being relied upon to develop treatments for diseases ranging from cancer to neurological disorders in biomedical research. The necessity of animal testing is supported by decades of evidence demonstrating its irreplaceability in drug development (Festing and Wilkinson, 2007). Yet, opposition to animal experimentation often arises from emotive responses rather than scientific considerations. Animal right groups frequently present misleading narratives that conflate research with cruelty, disregarding the extensive ethical frameworks and regulations in place to minimize suffering. While ethical concerns are valid, emotional rejection of animal research can obstruct scientific progress, leading to increased reliance on less effective alternatives.

6.3 Climate Change Denial and Economic Fear

Scientific consensus affirms that human activities are primary drivers of climate change (IPCC, 2021). Yet, climate science remains battle ground where emotional arguments- often fueled by economic fears, political ideologies, or misinformation, undermine scientific discourse. Climate change denial is frequently motivated by resistance to policy changes that could impact industries or economic structures. Emotional rhetoric, such as fears of governmental overreach or economic collapse, is often weaponized to challenge climate science, despite the overwhelming evidence supporting anthropogenic climate change.

6.4 Artificial Insemination and the Corresponding Stigma

Artificial insemination is a widely used reproductive technology, in both human fertility treatments and animal breeding programs (Gleicher et al., 2020). While the procedure is based on well-established biological and medical principles, public perception and ethical debates surrounding it are often influenced by emotional reasoning rather than empirical evidence. These emotional responses which are rooted in cultural, religious, ethical and personal beliefs- can shape attitudes toward artificial insemination, sometimes leading to resistance against its adoption despite its scientific validity.

The ethical and religious emotions have being the most prominent opposing bodies to assisted reproductive technologies, as some religious groups argue that artificial insemination disrupts natural procreation and sanctity of marriage, particularly in cases involving donor sperm (McLachlan and Swales, 2019). Catholic doctrine, for example, opposes artificial insemination when it separates reproduction from marital act, emphasizing natural conception as the morally acceptable approach (Congregation for the Doctrine of Faith, 2008). Also cultural attitudes towards fertility and reproduction influence how artificial insemination is perceived and accepted. In many societies, natural conception is deeply valued, and deviations from traditional reproductive methods can be stigmatized (Inhorn and Patrizio, 2015). These religious and cultural perspectives can lead individuals and communities to reject artificial insemination, even in cases where it is the only viable option for conception. Emotional resistance, rather than empirical evidence of the safety and effectiveness of artificial insemination often dictates these decisions.

7. Influence Of Emotions In The Regulation Of Biological Scientific Processes And Products

Regulation of biological scientific processes and products is essential for ensuring safety, efficacy and ethical compliance in various fields, including biotechnology, biomedicine, and agriculture. Ideally, such regulations should be based on empirical evidence, scientific rigor, and risk-benefit analyses. However, emotional interference usually driven by ethical and moral concerns, cultural beliefs, fear, past historical events and sometimes political agenda often tend to influence regulatory decisions. While it is acknowledged that emotions play an important role in human decision-making process, they can sometimes override objective scientific assessments in regulatory context. This emotional interference can lead to overly restrictive policies, delays in scientific advancements, and public resistance to beneficial innovations. Regulators, under pressure from

public sentiments and advocacy groups, may adopt precautionary policies that hinder scientific progress despite a lack of evidence supporting significant risks (Marris, 2018). In the areas of biotechnology, pharmaceuticals, and food sciences, emotional reasoning have shown to affect the regulation of biological sciences.

There is a fallacy that tends to address "natural" as inherently good while "unnatural" is bad – often drives opposition to biotechnology-based regulations. This belief has been termed the naturalistic fallacy (Gibson and Lawson, 2015). The case of genetically modified organisms (GMOs) provides a clear example of this. Despite overwhelming scientific evidence confirming the safety of GMOs (NASEM, 2016) and the global adoption of standard regulatory protocol (Cartagena Protocol on Biosafety- which ensures that application of GMOs do not pose any adverse risk to the conservation and sustainable use of biodiversity, taking into account risk to human health), but emotional concerns still staggers GMO regulation. These emotions are usually concerned with "tampering with nature" which have led to strict regulatory barriers. In his study identified that these regulatory delays, driven by public fear rather than empirical risk assessments, have prevented the commercialization of genetically modified crops that could enhance food security and reduce pesticide use (Smyth, 2020).

The regulation of pharmaceuticals and vaccines is another sector where emotional interference is visibly seen. Vaccine hesitancy, driven by misinformation and fear rather than scientific evidence, has influenced regulatory decisions and slowed public health responses (Lee et al., 2022). The WHO identified the play of emotional reactions to rare side effects of vaccines – such as the AstraZeneca Covid-19 vaccine's association with blood clotting, which led to temporary suspension in some countries despite data showing that the benefits far outweighed the risks (WHO, 2021). Similarly, the approval process for new drugs can be influenced by emotional responses to past medical controversies. The thalidomide tragedy of the 1960s, for example, led to much stricter regulations for drug approvals, which, while necessary, have also contributed to delays in life-saving treatments due to excessive caution (Kim and Scialli, 2011).

Stem cell research, particularly embryonic stem cell studies and outcomes, has faced significant regulatory challenges due to ethical concerns rather than scientific evidence of harm.The analysis showed that the emotional debate surrounding the moral status of embryos has led to restrictive policies in various countries, limiting research that could lead to treatments for degenerative diseases such as Parkinson's and Alzheimer's. Similarly, cloning of animals and potential for human cloning had been met with widespread emotional opposition (Lo and Parham, 2019). While ethical considerations are very valid, excessive emotional responses have hindered regulatory frameworks from distinguishing therapeutic cloning (which has medical potentials) and reproductive cloning (which raises moral concerns) (Hurlbut et al., 2017).

There is also the influence of the "yuck factor" which is an instinctive emotional repulsion to certain new technologies, even in the absence of scientific justifications. This has influenced regulations on lab-grown meat, insect-based protein, and genetically edited foods (Siegrist and Harmann, 2020). This has been shown in the case, where despite scientific evidences supporting the safety and sustainability of lab-grown meat, emotional reactions to the idea of "unnatural" meat have contributed to regulatory hesitations in many countries. Similarly, despite the nutritional and environmental benefits of insect-based protein, regulatory barriers persist due to cultural disgust, limiting its acceptance as a mainstream food source (van Huis, 2013).

There is also issue of political influence on science-based regulations as a result of public emotions. Regulations on biological products are sometimes shaped by political pressures, which can amplify public fears and emotions. In the United States of America, labelling requirements for GMOs were introduced largely due to public demand, despite scientific consensus that GMOs are no riskier than conventionally bred crops (Qaim, 2020). Political decisions influenced by emotional appeals rather than scientific consensus can lead to inconsistencies in regulations, affecting international trade and innovation.

8. Role Of Media On Emotional Interference To Biological Sciences

Media outlets, driven by the need to capture public attention, often misrepresent scientific findings and sometimes present scientific findings in oversimplified or sensationalized ways. Complex biological research is frequently reduced to misleading headlines that prioritize emotional impact over accuracy, leading to widespread misconceptions. For instance, media portrayals of vaccines have, at times, contributed to vaccine hesitancy by amplifying rare side effects while failing to communicate the overwhelming benefits and safety of immunization (Rodrigues et al., 2023). This selective framing reinforces fear-driven narratives rather than promoting informed decision-making.

The social media platforms on the other hand facilitate the rapid dissemination of misinformation, often amplifying emotional arguments at the expense of scientific accuracy. Algorithms prioritize content that elicits strong reactions, inadvertently promoting pseudoscientific claims over peer-reviewed research (Scheufele and Krause, 2019). To counter this, scientists must engage in proactive communication, utilizing accessible language to bridge the gap between scientific findings and public understanding.

9. Bridging The Gap Between Emotions And Evidence-Based Biological Sciences Research, Output And Regulation

To ensure that biological scientific processes and products including its regulation remain grounded in empirical evidence rather than emotional reasoning, several strategies can be implemented. They include:

i. Ethical frameworks should balance emotion and science. While ethical concerns are important, they should be integrated into biological science in a way that does not hinder beneficial advancements. Ethical frameworks should differentiate between emotional opposition and legitimate ethical concerns, ensuring that research, the outcome and the regulations are both justifiable and scientifically sound (Gostin et al., 2021). Transparent ethical policies and regulations can therefore help bridge the gap. Among these policies should include the integration of ethics education into bio-scientific trainings, which can help researchers navigate the complex interplay between emotional values and empirical evidence, fostering responsible conduct in research.

ii. Efficient science communication and public education remains important. Transparent science communication is crucial in addressing public fears and misconceptions. Educational initiatives that explain scientific processes, risks, benefits, safety and ethical considerations in an accessible manner can reduce emotional resistance and improve public trust in biological sciences and its regulatory decisions (Druckman and McGrath, 2019). Engaging relevant stakeholders such religious and community leaders in discussions about advanced biological sciences research, outcome and regulations may also help bridge the gap between emotional cultural beliefs and bio-scientific understanding.

iii. A risk-benefit analysis must be entrenched in policy making within the areas of biological sciences development. Regulatory agencies should emphasize risk-benefit analysis over emotional arguments when making decisions. For example, vaccine approval and GMOs authorizations should be based on data-driven assessments rather than reactions to isolated adverse events. Ensuring that policies are proportionate to the actual risks involved can prevent unnecessary regulatory hurdles (Gostin et al., 2021).

iv. Upholding an institutional culture of scientific integrity that mitigates cognitive biases and emotional interference will help bridge the gap. Education plays a crucial role in equipping individuals with the tools to critically evaluate scientific claims. Encouraging analytical thinking and scientific literacy from early age can help reduce susceptibility to emotionally driven misinformation. Bio-scientific institutions must uphold rigorous peer-review processes and ethical standards to ensure that research and its output remains free from ideological influence. Therefore, policies that promote evidence-based decision-making can help mitigate the impact of emotional biases. It is also important that biological scientists must take active role in public discourse, addressing concerns transparently and engaging with ethical considerations while emphasizing empirical evidence. Communicating uncertainty effectively is also key to maintaining credibility and trust.

v. Adoption of Independent or Ad-hoc Scientific Advisory Panels in some cases will help uphold empirical evidence and reduce emotionality influence in bioscience research and its output. Governments as the need arises, should adopt policies that encourage independent or ad-hoc scientific advisory panels to guide and support approval and regulatory decisions. These scientific advisory panels should usually comprise experts in the field for provision of objective assessments, reducing the influence of political or emotional biases on policy-making (Jack and Tateo, 2015).

10. Conclusion

The distinction between empirical evidence and emotional reasoning is crucial in understanding the scope and methodology of biological sciences. While emotions influence human perception and decision making, they do

not provide the rigorous, testable framework needed for bio-scientific discovery. Biological sciences rely on empirical methods – systematic observation, experimentation, and data validation- to uncover truths about life and its processes. Emotional reasoning while significant in human experiences does not meet the standards of scientific inquiry and therefore, should and must not override empirical evidence in biological sciences research, processes, products and regulations. Recognizing this distinction helps ensure that biological sciences remain objective, reliable, and free from subjective biases. By promoting science-based policies, improving public education and efficient science communication, and maintaining ethical balance, society can ensure that biological advancements and its regulation are done in a way that maximizes public benefit while addressing valid ethical considerations.

Conflict Of Interest

The authors declare no conflict of interest.

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