The Unwholesomeness of the Scientific Ecosystem

in the Research Misconduct: A Breach of Duty

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Abstract

Science is an important fixture in the human experience, and it has emerged from the shrouds of magic and fallacies. Science is now how humans come to understand the world around them. It is also the basis for the evolution and technological advancement of today's society. There are two major schools of thought in science: the inductive and the deductive (Wills, 2022). The latter has received wider acceptance and governs the experimentation (Wang et al., 2020). However, this process is marred by scientific misconduct when some researchers do not adhere to the rules of science for a variety of reasons (Lee, 2016). This threatens to compromise the integrity of our technological status and might even lead to catastrophic consequences. Examples include the fraudulent study on the cancer-fighting properties of plants published by Dr. M.D. Anderson (Ackerman, 2012) and Joachim Boldt published studies indicating that colloids are safe to use contrary to previous studies (Blake, 2011). It is therefore imperative to recognize these instances of misconduct and uproot them from the scientific community. The article is a review that looks into the articles dealing with scientific misconduct to develop an overview of the subject at hand. These incidents can be detrimental to the health and well-being of human beings. It can hinder progress as well as cause untold harm by the re-emergence of diseases that have already been conquered. It is recommended that we foster a culture of scientific integrity where everyone is aware of the importance of this issue. Moreover, journals can be more diligent in their reviews and reliant on peer reviews.

Keywords: science, scientific method, theory, misconduct, liability of misconduct

1. Introduction

As scientists, we have come to recognize the meaning of science without contemplating a concrete definition of what it represents because we are immersed in the practical application of all the standards and regulations that accompany this rich field. Britain's Science Council defines science as "The pursuit and application of knowledge and understanding of the natural and social world following a scientific methodology based on evidence" (Heintz, 2009). There have been numerous other definitions that stretch back centuries, and they have not all revolved around the practicesthat are taken for granted as non-contested practices although this assent took centuries of deep division between scientists, philosophers, and legislators until an agreement was reached. The confusion comes from the diverse aspects of science and how it continues to evolve thousands of years since its inception. This is because the understanding of science can be different according to the perspective. According to Mickens and Patterson (2016), science is the study of patterns which sounds simplistic enough at the beginning. However, spotting patterns is not the same in the diverse branches of science. For example, you will not use the same tools and strategies in sociology as you would genetics. Even quantitative and qualitative approaches offer numerous subtypes and often use different deduction methodologies (Abuhamda, Ismail, and Bsharat, 2021). This elusive nature of science has inspired much interest in the philosophy of science. Fara (2015) wrote that: "science is culturally situated, and so has neither a permanent nor a universal meaning". This fluidity allows the collective human knowledge to expand and evolve.

Science is now recognized as a human activity that seeks to find explanations for the natural phenomena of the world as well as the answers to the questions that plague humanity, but it can best be summarized as a cultural element whose characteristics, priorities, and methods (SAGE, 2018).

Despite having established a clear understanding and guidelines for scientific conduct in our community, there are still those who commit grave scientific misconduct for a variety of reasons that end up compromising the integrity of scientific research. A study by Wang et al. (2017) showcased an alarming trend of increased retractions of papers due to misconduct.

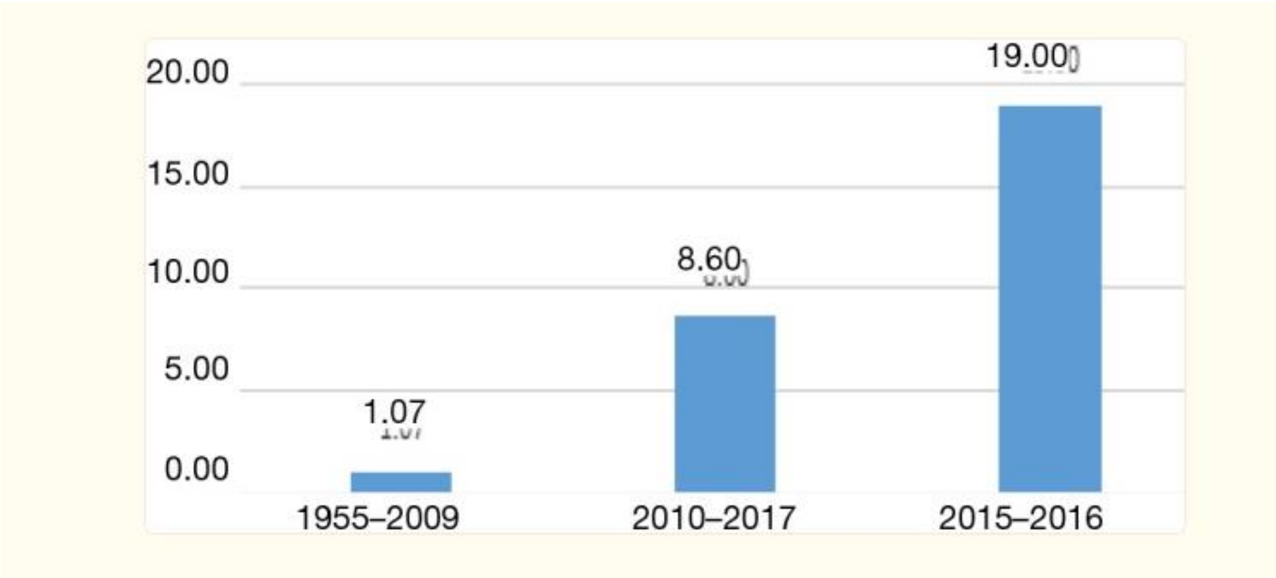

Fig. 1 The mean of retracted papers in neurosurgical publications as cited by Wang et al. (2017)

Moylan et al. (2016) estimated that only 15% of the retracted papers have unintentional errors in data analysis. The rest involve cases where there was a deliberate attempt to hide or skew results to support certain claims. An earlier study by Fanelli (2009) estimated that 1.97% of scientists have admitted to fabricating, falsifying, or changing the data to suit their desired outcome. Another 33.7% also confessed to being guilty of some questionable research practices without being specific.

This paper attempts to explore the possible causes for these anomalies and the consequences that might arise.It commences with describing the theories and definitions of science to provide the reader with anadequate background. The other sections will define the concept of scientific misconduct, its reasons, and the possible ramifications that might emerge.

2. Definitions in Science

Although different scientific research fields might seem very different at first glance, they all have common practices and guidelines that are synonymous everywhere. To gain a further understanding of the science and its methods, one must be better acquainted with these common practices.

The first process is known as an observation; it is the discovery and careful examination of the phenomenon, event, or problem that is to be addressed (Gale, 2001; Kraus, 2023) Discoveries can come about in a variety of ways, and some of the most famous is a product of coincidence But often, discoveries and observations result from a conscious desire of the observer to find a specific case or situation.

These observations will often lead to a question that originates from the curiosity of human beings (McLelland, 2007). Any observation has to be analyzed to be understood. However, the process becomes futile unless the observer is knowledgeable enough to know how to ask the right questions because they determine the direction the following steps will take.

When the right questions are asked, the researcher will be capable of forming a hypothesis. A hypothesis is the researcher's attempt to "find" or "guess" the answer to the problem the observation created (Mourougan & Sethuraman, 2017). No valid hypothesis can be developed without careful consideration and understanding of the situation. It is to be expected that the researcher must educate himself/herself by referring to the previous literature before attempting what is essentially an educated guess as hypotheses must be consistent with present knowledge and conducive for further studies.

A hypothesis can have only two results: valid or false. Some researchers even adopt a methodology where they try to prove the hypothesis invalid; this is useful in many situations when the means and/or technology for proving validity is not available. Some hypotheses might be valid, but they were not proven at one point in time until the proper technology and experimental setup became available.

Experimentation follows after hypothesis, and it is this step that often separates science from other disciplines. The logic behind designing an experiment is to prove or disprove the hypothesis that was established (Cash & Culley, 2015). Some hypotheses can only be proven by mathematical analysis. With the technology today, some hypotheses can be proven by simply entering the data into software specifically designed for this purpose. Regardless of the method by which they are proven, all experimentation must take place in a controlled and definedenvironment whether it occurs in the laboratory, in the field, or on a computer screen. All results must be reproducible and verifiable whenever the protocol is followed. There should also be a careful thought process to come up with an experiment that is unbiased and free from prejudice (Seltman, 2018). Sadly, this is the step upon which scientific misconduct occurs, a point that will,later on, be discussed at length.

3. Theories in Science

The scientific process might appear unidirectional to the untrained eyes, but there are diverse theories that govern scientific work. To start with a general statement, theories in science can be broadly divided into inductive and deductive reasoning. There are other classification criteria such as relying on quantitative or qualitative, but this section aims to focus on the methodologyadopted to design and conduct the scientific reasoning behind the research. Jupp (2006) defined induction as “a form of reasoning from statements about observed cases to statements about other, unobserved, cases or – more usually – to a general claim about most or all cases of the same kind”. “Induction, or inductive reasoning, moves from the particular to the general, froma set of specific observations to the discovery of a pattern that represents some degree of order among all the given events” (Babbie, 2010). Inductive reasoning is when the conclusion does notnecessarily follow the initial premise, meaning that it is possible or probable that the premise is true while the conclusion is false. It goes from the specific and then generalizes this to the rest of the population or situations. At first glance, one might assume that such a method is not based on scientific reasoning, but it is used in plenty of humanitarian sciences when quantitative and qualitative statistical studies can isolate a sample from a population and generalize the findings tothe rest. This is illustrated in Figure 1 where the pathway of inductive reasoning flows from observation, pattern, hypothesis to theory.

Figure 2: Pathway of inductive reasoning Sauce and Matzel (201

Miller-Brewer (2003) considered deductive reason as "… to draw logical conclusions by a process of reasoning; deduction is the process of reasoning by which logical conclusions are drawn from a set of general premises". It moves from the general to the specific. It is the transition between theoretical logical patterns that leads to observations that will verify whether the expected pattern occurs in the real world (Babbie, 2010). As seen below in Figure 2, it starts with a theorythat goes on to a hypothesis, observation, and confirmation. It starts with a truth that is generallyaccepted and reapplies it to a specific situation. By testing and observing the parameters of this particular case, a specific conclusion can be deduced for this specific area of investigation. It is sometimes referred to as the hypothetico-deductive reasoning because it works from a postulated hypothesis to reach a confirmation.

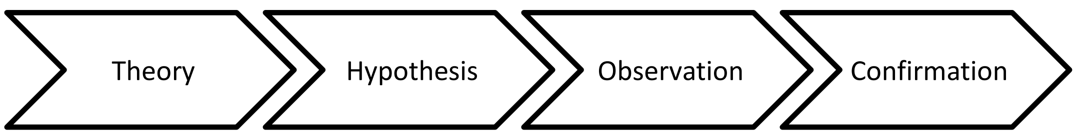

Figure 3: Pathway of deductive reasoning Steinberg (2017)

Deductive reasoning has certain requirements that need to be met for the process toproceed smoothly and yield concrete answers to the questions and hypotheses generated.

- All the premises that form the baseline of the experiment must already have been validated and are part of the acceptable body of knowledge.
- All the technical terminologies and numerical values must be properly defined and identified to leave no ambiguity.

- The first premise must be echoed in form and reasoning in all the resulting hypotheses and deductions made throughout the process.
- The results must either validate or falsify the premise. There is no room in deductive reasoning for two negative premises.
- Conclusions rely on the results of the experiment. No new information or ideas can be validated through the conclusion of one experiment; it needs to be confirmed or falsified by its own set of hypotheses and experiments.

4. Methodology

The literature in any field is constantly evolving with new findings added every day. This can make it difficult to keep track of the latest and most important findings. A literature review is an important methodology that should not be overlooked (Snyder, 2019). It can help to identify gaps and offer recommendations for new research (Synder, 2023). The process involves gathering data from various publications and consolidating the findings in a logical order to arrive at some conclusions and recommendations (Ramdhani et al., 2014).

5. Scientific Misconduct

The scientific community is plagued with scientific misconduct Candal-Pedreira, C. et al. (2023). Some were done willfully andothers due to ignorance. An example of unintentional misconduct is the case of Dr. Nina Bhardwai for choosing a statistical tool that would skew the results in her favor, an accusation that was disproved in a court of law (Resnick and Stewart, 2012). Perhaps the most famous deliberate example of misconduct is the link between the MMR vaccination and autism. Andrew Wakefield and his colleagues made this allegation in 1998, and after numerous studies refuting this claim, they retracted it in 2010 and were all accused of fraud (Rao and Andrade, 2011). The American Department of Health and Human Services defined scientific misconduct as the "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research or in reporting research results" (Bauchner et al., 2018). Not every case is done with malicious intent and not every act possesses the same level ofseverity, so they were divided into 2 categories.

Category 1 contains the most serious offenses including fabrication, falsification, and plagiarism in proposing, performing, or reviewing research results. They are considered a serious breach of the Good Research Practice (GRP) (Sox & Rennie, 2006). Fabrication is when results are made up and recorded as if they were real. Falsification is when the real results are edited or deleted to obtain a certain result that the data does not support. Plagiarism is presenting other people's ideasas if they were your own or using them without giving credit. (PSRCR, 1992; Helgesson and Eriksson, 2014). The3 are often referred to as the FFP. All three subcategories are found in different proportions indifferent scientific environments depending on various elements such as budget restraints, pressurefor publishing, and competition.

Behavior	All	Mid-career respondents (44-year-old)	Early-career respondents (35-year-old)
	n=3,247	54.5 % (1,768)	45.5.0 %(1,479)
Fabrication (%)	<0.03	<0.03	<0.03
Falsification (%)	15.8	20.8	10.0
Plagiarism (%)	1.4	1.7	1.0

Table 1 Percentage of US scientists engaged in FFP transgressions between 1999-2001 as cited by Martinson etal. (2005)

Table 1 clearly shows that falsification is the most prevalent type of FFP being conducted. There is much speculation regarding what drives scientists to falsify their results, but most researchers agree that it is a mixture of different factors that can be grounded in isolated individuals who are tempted to fabricate to publish, impure institutes that want to maintain their funding, and status, and some who claim that it is an inevitable result of the culture of modern science (Sovacool, 2008).

Category 2 is concerned with unacceptable practices that are not as serious as FFP, but they still constitute a breach of proper scientific and research conduct. They are referred to as the Questionable Research Practices (QRP) (Science Europe, 2015). Their severity ranges from unacceptable to almost harmless, but they are still a deviation from the norm of GRP, so they ought to be properly examined and minimized. There is no clear classification and identification of these offenses because there are too many to count. We will attempt to list some of the most common and serious in random order of severity and the admittance that others can be includedunder the umbrella of QRP.

1. Dropping observations: This is different from falsification as it simply disregards results based on an instinct that they are not relevant (Wagenmankers et al., 2012).
2. Camouflaging industrial connections: Industries are known to be financing scientists, and so it's important for integrity's sake that these connections are declared (AAAS, 2013).
3. Overstepping the rights of patients: Human testing requires that scientists adhere to the strictest ethical conduct and transparency with patients (EORTC, 2018).
4. Selective referencing: When presenting results, scientists must refer to the articles that support their results as well as those who disagree and have conflicting data (Duyx, 2017). This is also true for any manipulation done to undermine contradictory data to boost the importance of one's work.
5. Abuse of power: Workplace abuse exists even in science that ought to be rooted in fundamental facts, but often this is contradicted by those who exploit their position of power. This includes abuse of subjects, material, students, and other fellow researchers (Rosado et al., 2015).

A question arises as to why these scientists are tempted to such actions. Academic accountability is an issue that needs to be addressed because institutes are constantly pressuring researchers to provide publication material in the most prestigious journal possible which could involuntarily be promoting a culture that is open to misconduct (Pinto et al., 2008). Journals do conduct their research, but mostly the data provided are taken on trust which opens up the opportunity for corruption as the academic's job is largely autonomous (Chapman & Lindner, 2016). In universities, there is immense pressure from management to achieve high profiles in notable journals coupled with ineffective editorial vigilance has been conducive to fraud, and sadly most of the fraud cases are detected by whistleblowers and Ph.D. students (Gross, 2016). Arend (2017) also showed that journals often fail to follow up with the complaints and remarks that are sent, so corruption remains persistent as there is little chance of actual exposure. While it is easy to simply heap the blame on the researcher, some researchers claim that this pressure exerted will hinder the ability to even recognize that what is being done is immoral or unethical inthe first place (Jones & Ryan, 1998). Most researchers are being led astray about the QRPs regardless of their good intentions (Kim et al., 2015).

6. Conclusion

There is little empirical evidence about the causes and effects of scientific misconduct. One of the last extensive empirical studies estimated that 2% of scientists have participated in FFP and around 34% in QRP (Fanelli, 2009). On the other hand, only as low as 0.02% of papers are retracted across all disciplines (Van Noorden, 2011). Most would think that these instances of misconduct only occur in obscure journals, but that is not true. Korean stem cell researcher Woo Suk Hwang published two supposedly ground-breaking articles in Science in 2004 and 2005 (Bornmann, 2013). He claimed that he was able to develop embryonic stem cells. This had the potential to create organs that hold the same genetic makeup of the individual which would not cause an immunological reaction or rejection in cases of grafting and/or transfer of tissues and organs. It turned out that he unethically collected human cells and falsified the results. In the late 1990s, Andrew Wakefield and his colleagues published an article relating the vaccination of measles, mumps, and rubella with behavioral regression and persuasive developmental disorders in children. Although these findings were retracted by the researchersand publishers, the damage was done. There are still parents these days who refuse to vaccinate their children in fear they will develop autism (Rao & Andrade, 2011). We might think that scientific misconduct is something lurking in obscure journals or involving minor research, but the reality is that the dismissive attitude that theywere treated with was permissive to shaping a culture that is open for corruption and deception whether intentional or not.

Every researcher is aware of the consequences of misconduct, but it does not seem to stop it as the previous cases showed. It can be useful to focus more on scientific integrity for all those involved to create a culture of scientific integrity. Journals are encouraged to be more vigorous in their due diligence as well as rely more on peer review before publishing. Furthermore, when retractions are done, they must be given the same space and attention that the study had instead of burying it in obscure texts at the back of one publication.

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