

# Unethical Authorship is Research Misconduct

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# EXECUTIVE SUMMARY

Authorship confers several benefits such as professional advancement, social status, and personal gratification. In academia and research organizations, authorship is testimony of scholarship and expertise besides serving as a yardstick for individual promotion and tenure decisions. As a result, a few unscrupulous researchers indulge in various research misconduct and unethical authorship practices to amplify their publication count. The scope of research misconduct, at least in India, has been traditionally confined to fabrication, falsification, and plagiarism—the three issues that attract universal censure. But this overlooks other questionable practices, especially unethical authorship, that is equally detrimental to the integrity of the scholarly enterprise.

Authorship conventions vary across disciplines and organizations, but most publishers and professional societies provide explicit guidelines for assigning authorship. An author, accordingly, should provide substantial intellectual contributions in research planning, investigation, data acquisition, analysis, and writing. It was a series of misconduct scandals that surfaced in the United States during 1980s that motivated the International Committee of Medical Journal Editors (known as the “Vancouver Group”) to develop explicit criteria to prevent unethical authorship practices. Originally developed for biomedical research, these guidelines have been adopted by many other disciplines with suitable modifications.

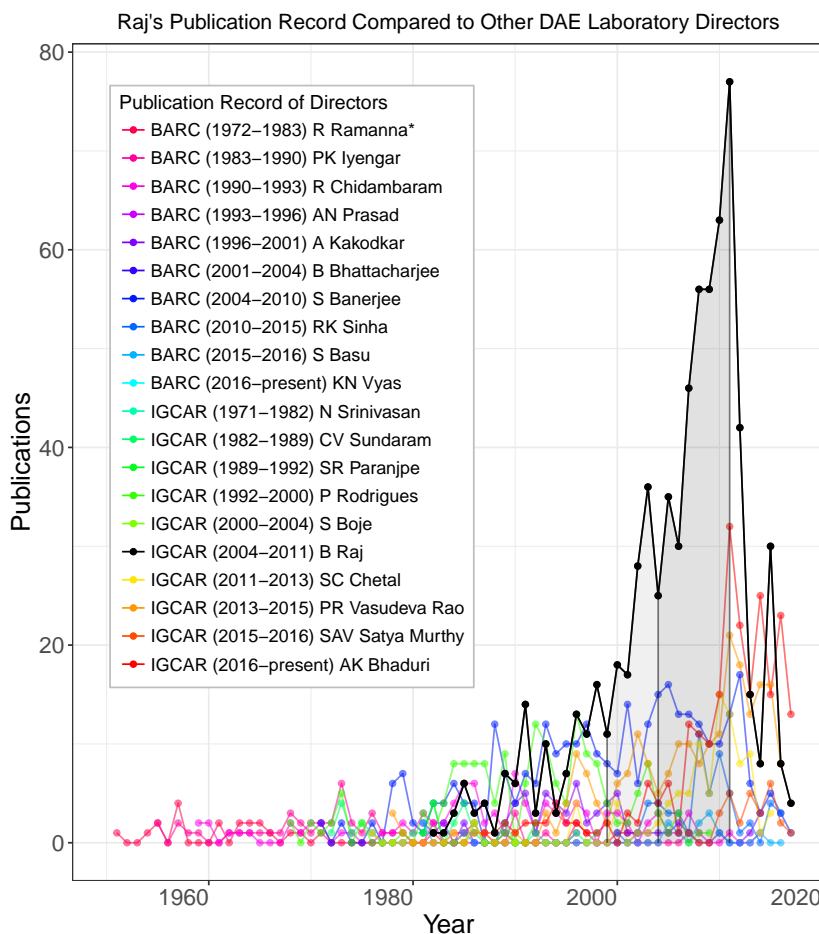
In particular, “guest, gift, and ghost” authorships are clearly unacceptable and inconsistent with the definition of what constitutes authorship. Ghost authors are professional writers who remain unnamed or younger researchers who provide substantial inputs (research and writing) to senior researchers but do not share authorship. Guest and gift authorships are offered to established researchers by their junior colleagues to increase the chances of publication or to derive some professional benefits. Often it is also part of the culture in certain research laboratories to give authorships to senior colleagues, head of the group, or lab director. An insidious form of this authorship is the coerced or pressured authorship, where the impetus to gain authorship comes from an undeserving senior colleague or head of the group. But this unethical practice is also the least discussed and most difficult to detect.

In a public lecture “A Survey of Academic Ethics” at the Indian Institute of Science on June 23, 2017, Sunil Mukhi, a senior faculty at the Indian Institute of Science Education and Research (IISER) in Pune as well as Chairman of the Committee on Scientific Values at the Indian Academy of Sciences, alluded to this as the “Director Effect.” This happens when an unscrupulous leader uses his administrative position to create conditions that lead to high numbers of guest and coerced authorships.

While unethical authorship practices are widespread, authorship misconduct involving those holding positions of power is largely anecdotal and difficult to establish in the absence of a formal internal complaint by a whistleblower. It is now possible to detect plausible authorship misconduct using large academic databases like Elsevier’s Scopus or Web of Science in combination with publicly available information about a person’s professional history.

In this paper we report a spectacular case of plausible authorship misconduct by a well-known scientist administrator Baldev Raj. Raj is the former Director of the Indira Gandhi Centre for Atomic Research (IGCAR), a Department of Atomic Energy (DAE) lab working on breeder reactor research and development, and presently Director of the National Institute of Advanced Studies (NIAS), an institution established by the late J.R.D. Tata and partially funded by the Tata Trusts. In February 2017 Raj was appointed by Prime Minister Narendra Modi as the Chancellor and Chairperson of the Board of Governors of the Academy of Scientific and Innovative Research (AcSIR), which is a deemed university comprising various CSIR labs and institutions.

Raj has a prolific publication record of 714 Scopus tracked peer reviewed works but more than 1300 publications according to his recent curriculum vitae. His productivity level is exceptionally unusual when compared to any other leaders of DAE establishments. A summary of our investigation using data from Scopus is depicted in the figure below. It clearly shows that Raj's publication record is unique. In 2011, the last year of his tenure as Director of IGCAR, Raj's research productivity peaked at 77 publications (one every 4.7 days). Raj's tenure as IGCAR Director (2004-2011) were his most productive years during which he authored 388 of his 714 Scopus tracked articles, which represent 54% of his lifetime output. These results and corroborative qualitative and anecdotal inputs from some of Raj's former and current co-authors at various institutions provide prima facie evidence for a strong case of plausible authorship misconduct throughout much of his professional career. Any serious researcher will find the high productivity and the astonishing productivity growth while holding senior administrative positions rather suspicious. It is imperative that concerned authorities launch a transparent and impartial investigation into what appears to be a startling case of authorship abuse and potentially other forms of research and professional misconduct.



Note the exceptional publication record of Baldev Raj when compared to all BARC and IGCAR directors post 1970 tracked by Scopus. We highlight the directorship years of Raj (2004-2011) and the five years (1999-2003) preceding it.

# Introduction

Authorship confers several benefits such as professional advancement, social status, and personal gratification. Besides fame and pecuniary rewards, the sheer excitement and felicity of seeing one's name in the byline can be a source of motivation to write for even the most seasoned authors. In academia and research organizations, authorship is testimony of scholarship and expertise besides serving as a yardstick for individual promotion and tenure decisions. Not surprisingly there are myriad publishing outlets to meet every conceivable disciplinary and interdisciplinary turf demand. About 28,100 scholarly journals across various disciplines exist in English language alone publishing close to 2.5 million articles every year, and Google Scholar indexed approximately 160 million documents including journal articles, books, and grey literature in 2015 (Ware and Mabe, 2015).

In earlier times, scholars in various disciplines published primarily to announce new findings to their peers and benefactors or to popularize arcane knowledge to a broader audience. Isaac Newton, for instance, was known to be secretive and reluctant to publish and had to be persuaded by friends or goaded by his adversaries into publishing his scientific and mathematical discoveries. What is even more remarkable about science's greatest icon is he left behind a voluminous trove of writings on a range of subjects and chose not to publish them during his lifetime. Scholarly journals, the primary source for communicating and validating new findings in every field and subfield, trace their origins to the mid-seventeenth century when Henry Oldenburg, then secretary of the Royal Society, created *Philosophical Transactions* as a for-profit entity (LaFollette, 1992). Although there are scattered accounts of existence of peer review system around the time, it was not institutionalized until the mid-twentieth century. Some of the famous scientists and scholars of the two preceding centuries have a slimmer publication record compared to a typical career researcher now. Thanks to the intense competition for jobs in academia and research organizations, authorship is used as the primary indicator of a person's research capabilities and potential.

However, the pressure to “publish or perish” has spawned a culture and reward system that is obsessively and disproportionately focused on quantity rather than the quality of publications. As a result, shoddy and mediocre works dominate the landscape of published literature in many fields. Some indulge in research misconduct and various unethical authorship practices to amplify their publication count. The actual scale of research misconduct worldwide is not precisely known but is likely to be much greater than the number of formally reported cases, of which only a small fraction is subject to transparent and impartial inquiry.

But confining the scope of research misconduct to only fabrication, falsification, and plagiarism—the three issues that attract universal censure—and glossing over other dubious research practices is problematic and detrimental to the integrity of the scholarly enterprise. In particular, various forms of unethical authorship practices leave a corrupting influence in institutions and could potentially encourage researchers to commit outright research fraud. Moreover, the lack of consensus on authorship norms and standards across disciplines has allowed unscrupulous senior researchers to exploit vulnerable junior colleagues and get away with various unethical practices.

Since research misconduct is mostly driven by a skewed incentive structure favoring publication

count, expanding the scope of definition of research misconduct to include unethical authorship is long overdue. Academic societies and journals have long deplored unethical authorship practices and periodically highlight the danger it poses to research and professional integrity. But the onerous task of educating the researchers on publishing ethics and ensuring they comply with them is mostly left to individual institutions. While the three dominant concerns of research misconduct (fabrication, falsification, and plagiarism) have mechanisms for identifying and rectifying wrongdoing by researchers, a journal editor has no means of knowing whether a listed author meets the authorship criteria to merit inclusion. Some of the top-rated journals require explicit statement on the nature of contribution of all listed authors in the reported work, which allow editors to include or exclude anyone as they deem fit. With the gradual disappearance of single authored articles in many disciplines and the difficulties in assigning appropriate credit in large research projects, the traditional notion of authorship itself may have to be reconsidered when a paper lists hundreds of authors. This problem is quite prominent in biomedical research, high-energy physics, and large social sciences projects. Multi-authored articles also easily mask freeloaders and predators.

Even in countries that have national policies and institutions to report research misconduct in universities and other research organizations, mechanisms for conducting a transparent and impartial inquiry into misconduct allegations are weak. Because of the negative publicity they invite, institutions have traditionally been cagey about misconduct allegations. High profile misconduct cases and retractions of papers bring greater embarrassment to the institutions and people who may have been unwittingly involved. On the contrary, institutions have only enhanced their reputation by acting promptly and fairly to allegations of research misconduct. Likewise, journals with high retraction rates command greater respect and credibility. If high ethical standards are expected of everyone while doing research, it follows that the same standards also be applied to reporting it. This requires treating all forms of unethical authorship practices at par with fabrication, falsification, and plagiarism.

India lags behind in establishing credible institutions to monitor research misconduct and unethical authorship practices and remains in the dubious company of countries lacking a national policy and institutional mechanism to address research misconduct. The respect for hierarchy and conspiracy of silence by entrenched interests pose additional challenges to report, investigate, and adjudicate research misconduct in Indian institutions.

In this paper we review various types of research misconduct and unethical authorship practices and their implications for academic freedom and research integrity. First, we begin with a historical and contemporary review of research misconduct using some notable examples. This will be followed by a discussion of acceptable and unacceptable authorship practices and highlights of various forms of the latter. In the next section, we review a special category of unethical authorship abuse known as the “White Bull” phenomenon and report a spectacular case of plausible authorship misconduct using Elsevier’s Scopus academic database. The paper ends with a discussion of various options available to address research misconduct and their limitations.

## Misconduct in Research

Research in various fields has evolved as a social process for which strict observance of professional codes of conduct and ethical norms is essential. While natural sciences, social sciences, and the humanities have specific norms and standards for adherence of its members, they share the same values such as “honesty, fairness, objectivity, openness, trustworthiness, and respect for others” (National Academy of Sciences, 2009). Any violation of one or more of these values and actions or behavior that fall short of the established standards of professional ethics is considered as research misconduct. The research enterprise operates on the premise that all of its members will uphold time-honored values of trust and integrity in their individual and leadership capacities. But research misconduct is also a fuzzy and amorphous term. Defining what specifically constitutes it remains problematic and differs across disciplines and cultures even though it is not difficult to identify when one encounters it.

One of the earliest professional and ethical codes of conduct is the Hippocratic Oath, which obligated physicians in ancient Greece to perform only beneficial treatments on their patients and avoid causing any injury to them knowingly and uphold the highest ethical and moral standards in their personal and professional lives. It is still a tradition for students of medicine to swear by the classical version of this oath or some modern variant of it upon graduation. Other professional codes of conduct in earlier times were typically transmitted from practitioners to apprentices who then passed it on to succeeding generations. The expansion and professionalization of research in various disciplines during the twentieth century resulted in setting up codes and norms for research. Initially developed for science and engineering research, other disciplines have adopted common ethical norms and practices from them.

If research is meant to be a quest for discovering truth, research misconduct is antithetical to this fundamental objective. Science, in particular, operates on the assumption that researchers will remain ethical and truthful in the process of conducting and reporting their work. Broad and Wade (1985) provide several examples in *Betrayers of the Truth* of research misconduct in the history of science that shows some of the famous figures like Hipparchus, Ptolemy, Galileo, Newton, Bernoulli, Mendel, and Millikan in poor light. The Greek astronomer Hipparchus had apparently copied and published a star catalogue from Babylonian sources conveying the impression that he made those observations himself. Claudius Ptolemy, whose geocentric theory of solar system held sway for nearly 1500 years until it was replaced by the heliocentric theory during the Scientific Revolution, included in *Almagest* many astronomical observations he claimed to have made but actually derived them from theory and computation. A science historian rated Ptolemy as the “most successful fraud in the history of science” (Wikipedia, 2017). Galileo exaggerated the results of some of his famous experiments while Newton used a “fudge factor” to improve the predictability of his lunar theory. Newton also held controversial views and beliefs but carefully hid them from public. Bernoulli plagiarized his son’s work and backdated his book to give the impression that it was published before his son’s birth. The results of Mendel’s experiments with peas which laid the foundation of genetics were statistically neat and now considered “too good to be true.” Robert Millikan discarded all outliers while measuring electric charge because they were not compatible with

theory. The English psychologist, Cyril Bert, was posthumously held guilty of fabricating data to support his theory that human intelligence is predominantly inherited although the integrity and validity of his other earlier work in the field remains intact. Charles Dawson, an amateur archeologist, presented fake fossils from the Piltdown site near Surrey in England in 1912 to suggest Britain as the cradle of humanity (Natural History Museum, 2017). For more than three decades that claim was widely accepted until a biological anthropologist and a human anatomist from Oxford University proved in 1949 the Piltdown Man to be a sophisticated hoax.

It is not clear whether contemporary norms and standards can be applied in the case of historical figures even though elements of what would now be classified as research misconduct can be found in the examples recounted earlier. Fabrication, falsification, and plagiarism are the three principal forms of research misconduct that are universally condemned by the research community in all disciplines. In many developed countries it will attract government attention or even intervention to conduct appropriate investigations if the research is publicly funded. The OSTP (2017) defines research misconduct as “fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.” The US National Science Foundation defines them as follows: “Fabrication: making up data or results and recording or reporting them; (2) Falsification: manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record; and (3) Plagiarism: appropriation of another person’s ideas, processes, results or words without giving appropriate credit” (National Science Foundation, 2002). Falsification of data defined in the context of research misconduct is quite different from “falsifiability” used by Karl Popper in scientific epistemology. The NSF earlier used to have a fourth category to cover “deviant practices” that allowed it to investigate various unethical practices but adopted a more narrow definition after resistance from scientists.

Unverifiable claims that violate known scientific laws and common sense, even if they involve fraud and deceit, are not typically covered under research misconduct. While fraudsters make such claims to deceive others to make money, there are some researchers who engage in willful duplicity or obstinately hold on to claims that are not empirically verifiable. In 1989 two electrochemists, Martin Fleischmann and Stanley Pons, from the University of Utah who attracted worldwide attention, made a sensational claim of achieving nuclear fusion at room temperature (“cold fusion”) in a tabletop experiment using metals loaded with deuterium. Several research groups around the world including India repeated the experiment to validate the chemists’ claim. But after mixed results from the verification experiments, an expert panel appointed by the US Department of Energy reviewed the original claim and subsequent experimental results and concluded that cold fusion does not merit further scientific attention. However, dedicated groups of researchers in different countries continue to work and reiterate the claims of Fleischmann and Pons. Unlike cold fusion research, which has some semblance of credibility, certain scientific claims that surface periodically are outrageous. One theme that refuses to die is perpetual motion even though the US Patent Office summarily rejects any claim that violates the second law of thermodynamics. Demonstrations of contraptions that supposedly generate “free energy,” “vacuum energy,” and “energy from air” have been regularly reported. In the 1990s a senior administrator from the Nuclear Power Corporation

of India Limited (NPCIL) regularly duped journalists to write about a prototype machine he had “invented” and set up in the foothills of Western Ghats near Karwar. He claimed generating energy from literally thin air and escaped formal censure of his organization and other professional societies while still holding an official position. Ramar Pillai, a school dropout from Tamil Nadu, defrauded educational institutions and governments two decades ago claiming he had invented a method to produce non-petrochemical fuel using herbs. He continued to receive funds and patronage from various public and private sources until his sleight of hand was exposed during a validation experiment at IIT Madras in 1996. Cold fusion is an example of “obstinately holding on to claims that are not empirically verifiable” while Ramar Pillai’s claim an example of “willful duplicity.”

Much has been written during the past four decades about various scientific research misconduct cases due to fabrication and falsification of experimental data. In one of the most audacious attempts of scientific fraud, William Summerlin, an immunologist working at New York’s Sloan-Kettering Institute, claimed in 1973 to have transplanted human corneas into rabbits’ eyes without rejection and suggested a huge promise for transplant surgery (Broad and Wade, 1985). In an attempt to get publicity to enhance his fund-raising prospects, the immunologist broke the news at a journalists’ meet before his claim could be replicated by others. While media coverage made Summerlin an instant celebrity, his own research group and others had difficulty in replicating his experiment. Nobel laureate Peter Medawar himself took interest in Summerlin’s experiment but had doubts about the claims made. He later admitted lacking moral courage to flag the case of potential scientific fraud that he suspected in Summerlin’s case from the beginning. Summerlin’s fall from grace happened a year later in 1974 when his lab chief confronted him and asked to reproduce the results. Under pressure, Summerlin faked transplantation experiments by using a black felt-tip pen to darken the transplanted skin patch in two white mice (Lock, 1994). The lab assistant who was witness to the fraudulent behavior reported promptly and Summerlin was sent on sick leave for one year with full pay. After this incident government funding agencies in the US took steps to have formal mechanisms to deal with research misconduct cases.

Another well-known misconduct case that came to light during the early 1980s was that of Elias Alsabti, an Iraqi born cancer immunologist with Jordanian connections who had come to the United States as a PhD student and moved from one institution to another as postdoctoral researcher building a formidable publication list until he was proved guilty of one of the three worst research crimes: plagiarism. Broad and Wade (1985) devote an entire chapter to discuss this case in their book on scientific misconduct. Alsabti’s modus operandi was to copy published articles of other authors and publishing them with his name in obscure journals that didn’t come to the attention of his peers. His goal to show an impressive publication count was no different from any career researcher except his brazen theft of entire papers verbatim. That his publishing exploits took more than three years to detect also reveals the limitations of science’s self-correcting mechanisms through peer review. Even after getting caught, Alsabti had little difficulty finding jobs and would move from place to place, continue the same pattern of stealing and publishing until getting caught.

A notorious case of research misconduct that came to light in 1980 involved a young Indian medical researcher Vijay Soman who had migrated to the United States from India in 1971



(Broad and Wade, 1985). After a brief stint at Albany Medical College, Soman joined Yale University's School of Medicine as an assistant professor in 1976 and specialized in diabetic research and worked in the lab of Philip Felig, a chaired professor and well-known researcher in the field. Sometime during 1978 Felig received a paper to review from the *New England Journal of Medicine* that reported results from a study of insulin binding in patients suffering from anorexia conducted by a researcher from the National Institute of Health (NIH). Since he knew that Soman had interest in the field and had proposed to conduct a similar study, Felig asked him to review the paper (which itself was unethical) and the outcome of the review process was to reject its publication. Within a few months Soman sent a paper with Felig as co-author to *American Journal of Medicine* reporting results from a similar study. Their paper by strange coincidence landed on the desk of Helena Rotbard, the NIH researcher whose study Felig had deemed not worthy of publishing. Rotbard was appalled to find several passages lifted verbatim from her manuscript in the paper she was asked to review. She took it up with the journal editor and also complained to the Dean of Yale's School of Medicine. After a long and protracted investigation Soman admitted to committing plagiarism, and during the investigation he was also found guilty of falsifying data to fit a graph in the paper. With his name tarnished Soman's continuation at Yale became untenable and was asked to leave Yale while Felig didn't even receive a light rap over his knuckles for his indirect role in that research crime.

But the most famous research misconduct case to hit the headlines that also got the government funding agencies deeply involved was the John Darsee case in 1981 because it involved prestigious institutions, coauthors, and journals (Broad and Wade, 1985). Darsee was a young and enterprising postdoctoral researcher working in the lab of the distinguished cardiologist Eugene Braunwald at Harvard University and had been churning out an impressive number of papers in top journals, adding his boss as a coauthor in his research papers besides gifting authorship to his junior colleagues and graduate assistants in his lab, some of whom were only tenuously associated with his work. Braunwald was then managing a \$3 million National Institutes of Health (NIH) grant besides working as chief doctor at two of Harvard's famous hospitals. Darsee's prolific output in cardiovascular research within a short span led Braunwald to even consider setting up a separate lab for his young protege, which was an unusual distinction then for an upcoming biomedical researcher in his 30s.

While Darsee was highly regarded among his peers for displaying phenomenal research productivity, some of his younger colleagues who had been noticing him at work grew suspicious of the rate at which he was producing papers. Once they caught him falsifying data in a lab study and reported to authorities, but Darsee assured Braunwald that it was a single incident of wrongdoing. Very soon it became clear that Darsee's other experimental data, including his work for the large multi-institution study of treatments to protect the damaged heart muscle after a myocardial infarction, were also forged. Harvard University and other institutions where Darsee had work earlier conducted investigations and showed him to be a serial offender committing research and academic misconduct since his undergraduate days at University of Notre Dame (Lock, 1994). After these investigations many of his papers containing fabricated and falsified data were retracted by some journals.

It was the public disclosure of around a dozen cases of research misconduct that surfaced

between the Summerlin and Darsee scandals that prompted U.S. Congressional intervention for the first time making it a significant public issue. In 1981 former Vice President Al Gore, who was then a young Congressman from Tennessee, chaired the Investigations and Oversight Subcommittee of the House Science and Technology Committee to hear about the various research misconduct cases that had surfaced (Office of Research Integrity, 2017). The Congressmen who heard the testimonies of various senior scientists during the period were both aghast and angry at the prevailing attitudes of the scientific establishment dismissing research fraud as “rare” and the fervent belief in the checks and balances science already had to deter and detect dishonest practices (Broad and Wade, 1985). The US Congress kept the pressure on the scientific community over the issue after more cases surfaced and due to the public criticism that the universities and other research institutions were not doing enough to stem the tide of research misconduct and remained indecisive in responding to misconduct allegations. It was in this atmosphere the Health Research Extension Act was passed in 1985 in the United States which required the Secretary of Health and Human Services to issue a regulation requiring institutions receiving public funding for research to establish credible internal mechanisms to investigate research misconduct cases. The Office of Research Integrity (ORI) was subsequently established in the Department of Health and Human Services to oversee whether the institutional mechanisms work adequately in the awardee institutions. The number of investigations by institutions submitted to ORI has remained quite low with an average of 24 reports per year (Titus, Wells et al., 2008). Although the numbers suggest significant underreporting, these initiatives did prod the US institutions to take allegations of research misconduct seriously and conduct prompt and credible internal investigations.

However, nothing would deter committed fraudsters. In 1985, the same year ORI was established, Robert Slutsky, a clinical faculty in the Department of Radiology at the University of California, San Diego, was found guilty of committing extensive research fraud (Engler, Covell et al., 1987). A faculty committee comprising ten members reviewed Slutsky’s 137 articles published during the preceding seven years and concluded that 12 papers were fraudulent and 48 questionable. This resulted in retraction of many of his papers although journals declined to retract the studies in which Slutsky was involved. But the scientific community tends to be defensive whenever such cases of misconduct erupt by dismissing them as a rare occurrence. Some of the worst cases of research fraud to hit physics in recent memory were that of Jan Hendrik Schoen and Victor Ninov (Dalton, 2002). In 2002 Schoen, employed at Lucent Technologies’ Bell Laboratories, was found guilty of fabricating and falsifying data in at least 16 papers in semiconductor research, some of which were published in *Nature* and *Science*. The same year Ninov, who was a physicist at Lawrence Berkeley National Laboratory in California, was found guilty and fired for fabricating data to claim creation of heaviest known elements 116 and 118. The labs where the disgraced physicists worked were praised for acting swiftly and reinforcing the belief that science is “self-correcting.”

A common feature of many high profile cases is that they involved scientists working in projects with high economic stakes, especially biomedical research. Research misconduct having implications for public health is taken more seriously by funding agencies. Another area that has similar public health concerns nuclear safety and food safety research, where there are spillover effects from industry to research they support. For example, in 2002

Japan’s major electric utility TEPCO admitted that it had been falsifying safety records for many years to cover evidence of cracks in three of its plants in Fukushima (Lochbaum, Lyman et al., 2014). TEPCO’s chairman resigned when the cover up became public, and the new chairman admitted the falsification of nuclear safety records as the “gravest crisis” of the company since its founding. In 2007 more revelations surfaced when TEPCO admitted falsifying more records involving about 200 incidents dating back to many years. In this case, TEPCO’s technicians regularly falsified records to pass the inspection tests since passing the test and saving costs for the company became the primary objective rather than taking remedial measures to ensure public health and safety.

In China concerns in this regard can be traced to the late 1990s when some high profile cases of plagiarism initiated a national discussion about research integrity (Henry, 2017). At that time the Chinese academic leadership warned that the country will not achieve its potential to become a “research powerhouse” if the institutions failed to address dishonest research practices. Thanks to a growing economy and increased research spending, China has now emerged as the second largest research hub after the United States. The number of Science Citation Index (SCI) papers from Chinese researchers increased from 41,417 in 2002 to 193,733 in 2012 (Hvistendahl, 2013). According to SCI’s journal-ranking database, China’s share of global scientific research output grew from 3.5% in 1999 to 18% in 2015 of scientific studies published globally, according to the journal-ranking database (Henry, 2017). But the high incidence of research misconduct in China also pulls down its image. Even though the Chinese government and academic institutions have established policies to stem the tide of research misconduct, use of monetary incentives for publications in international journals appears to undermine those initiatives. In the early 2000s Chinese institutions gave researchers bonuses of \$2,500, which was then comparable to their baseline salaries, for a paper in *Science* or *Nature* (Henry, 2017). Because publications in top journals in the field ensures promotions and monetary rewards in Chinese institutions, instances of research misconduct and unethical authorship practices are also widespread. Recent financial rewards in China for the first author of a *Nature* paper is \$44,000 (Quan, Chen et al., 2017).

The incidence of research misconduct in India, where there is gross underreporting, is also high. T. A. Abinandanan, a faculty at the Indian Institute of Science who regularly tracks and blogs on research ethics, presented in a 2011 meeting organized by the Institute of Mathematical Sciences and the Forum for Global Knowledge Sharing, data showing a rise in the retraction of papers authored by Indians in international biomedical journals. During the period between 2001 and 2010 he covered in the presentation 70 papers were retracted out of 103,000 published papers, which include 45 cases of fabrication, falsification, and plagiarism (Raman and Padma, 2011). Patnaik (2016) cites the same study of Abinandanan which puts the average retraction rate of Indian researchers at 44 per 100,000 published papers, which is much above the world average of 17. Besides promotions, other academic privileges such as securing research and travel grants, memberships in prestigious academies, and monetary and honorary awards largely depend on a researcher’s credentials as measured by publication count. In India these resources are mostly controlled by small groups of elite who form the “science cartels” in different fields, where nepotism and mediocrity is significant. The drivers of research misconduct in India are thus obvious.

Many high profile research misconduct cases from India have been reported in both national and international journals. Pattium Chiranjeevi from Sri Venkateswara University (SVU) in Tirupati was found guilty of committing extensive falsification and plagiarism in more than 70 research papers he published between 2004 and 2007, and it took a researcher from the University of Texas to discover his fraud (Patnaik, 2016). Even though his university conducted an internal inquiry, Chiranjeevi continues as a faculty member at SVU. Another misconduct case reported in the press in the 1980s is that of Vishwa Jit Gupta from Panjab University in Chandigarh who published around 450 papers (Patnaik, 2016). Again it took a foreigner, an Australian geologist, to expose Gupta's wholesale misconduct. After a long and protracted inquiry, Gupta was denied promotions and increments and stripped of all administrative powers by the university. In 1995 R. Vijayaraghavan, a professor from the Tata Institute of Fundamental Research (TIFR), was accused of plagiarizing his student's doctoral thesis (Raj, 2002). The Society of Scientific Values (SSV), a Delhi-based initiative to monitor and inquire into cases of research misconduct, lists several cases that have come to its attention and the last case it took up to investigate was in 2009 relating to plagiarism (SSV, 2017).

Plagiarism appears to be the most common type of research misconduct involving Indian researchers, while fabrication and falsification, according to former *Current Science* editor and IISc Director P Balaram, is "rare and more sophisticated." Commenting on the harsh reality in India, Balaram rued there is a tendency to severely punish junior researchers in such cases while letting off senior scientists lightly as they are protected by institutional interests (Raj, 2002). Balaram has written several influential editorials on the subject of research misconduct in the journal he edited for many years (Balaram and Ramaseshan, 1995; Balaram, 2005; Balaram, 2007; Balaram, 2010). Unethical research practices are reported to be common even at IITs and Central Universities and dealing with them is more complicated because of the lack of sufficient expertise in many fields to reach a credible judgment. There is also a general cynicism about the effectiveness and fairness of misconduct investigations in India because of the perception that some of the reputed scientists "have their own cliques whom they will help and protect" (Sabir, Kumbhare et al., 2015).

Some well-known Indian scientists and science administrators have been embroiled in plagiarism cases but escaped censure by scapegoating a junior researcher. In the past some of the Vice Chancellors (Pondicherry University, Delhi University, and Kumaon University) were found guilty of research misconduct. The famous case of course is the Former Vice Chancellor of Kumaon University V.S. Rajput who committed several unethical practices publishing papers of others in his name as well as publishing the same paper multiple times. This case was taken up independently by SSV which examined his papers (SSV, 2017). Rajput shifted the blame on his former student, but investigations revealed that he rewarded that student with a faculty position in the university. After a "considerable moral pressure" exerted by prominent physicists in India and abroad, who had petitioned to the President, Governor, and the Minister of Human Resources, Rajput was formally investigated and forced to resign. Even more recently, Appa Rao Podile, Vice Chancellor of the University of Hyderabad, was found guilty of plagiarism in multiple scientific articles coauthored by him (Mukunth, 2016).

While the research community and publishers promptly investigate plagiarism charges, they

show greater reluctance to involve in allegations of fabrication and falsification because of the time and complication any investigation of the latter involves. This is largely because researchers are exposed to the seriousness of plagiarism as students in their training. Computer-based plagiarism detection tools such as Turnitin and others are helpful to detect and quantify the originality of academic work (assignments, term papers, and theses). Even in countries where students and researchers are exposed to these issues plagiarism is significant. In the United Kingdom, more than 58,000 undergraduates have been investigated by their universities for plagiarism during the past four years (Singh and Remenyi, 2016).

While the misconduct cases reviewed so far involves one or more of the three concerns that attract censure, other unethical practices have largely escaped attention. The US National Academies also identified 25 years ago various “questionable research practices” that breach the traditional values of the research enterprise and its negative implications for the research community (National Academy of Sciences, National Academy of Engineering et al., 1992). But there has never been a consensus how to evolve standards for them and left it largely to individual institutions to define and enforce them as needed. Although scientists have reservations mixing unethical professional conduct with scientific misconduct, they have long argued for bringing them under consideration because they “erode confidence in the integrity of the research process and weaken the education of new scientists.” In many instances professional misconduct is the means by which research misconduct is committed. Farthing (2014) says that questionable research practices, in contrast to the view that they are “less serious,” may quantitatively have a greater negative impact on research outcomes and the research culture of institutions. The American Geophysical Union (AGU) recently suggested even expanding its definition of misconduct in scientific research to include sexual harassment, reviving a contentious debate in the 1990s which resulted in the narrow definition that most institutions adopted earlier (Kuo, 2017). According to a survey of misconduct policies by Resnik and Neal et al. (2015) of the top 200 U.S. research institutions, most institutions now consider all deviations from accepted norms such unprofessional conduct and unethical authorship practices as unacceptable. Resnik and Rasmussen et al. (2015) say earlier definition was very restrictive and omits many categories of research misconduct such as “unethical authorship, unethical publication practices, conflict of interest mismanagement, unethical peer review, misconduct related to misconduct investigations, poor record keeping, other deception and human or animal research violations.”

In response to these concerns many institutions worldwide have revised their misconduct policies and guidelines which repeatedly emphasize ethical behavior in individual and leadership capacities. Four recent documents are relevant to the discussion of this paper: 2010 Singapore Statement on Research Integrity; 2011 European Code of Conduct for Research Integrity; 2012 Inter Academy Council Report; and 2013 Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations. Of these the 2012 Inter Academy Council Report is widely representative since it comprises a global network of various science academies (Inter Academy Council, 2012). This report describes the issues not traditionally covered under research misconduct as “unethical, undesirable, and irresponsible” behavior and conduct. It also deplores requesting or conferring authorship without merit, a subject of discussion in the next two sections of the paper.

# Unethical Authorship Practices

The primary motivation for research misconduct, as described in various cases earlier, is unmistakably to gain authorship in publications. Hence it is surprising and odd that unethical authorship practices have not received comparable censure that fabrication, falsification, and plagiarism attract. Authorship conventions may vary across disciplines and organizations, but most publishers and professional societies provide explicit guidelines for assigning authorship. Even if a research project involves collaborating with investigators from different disciplines, most guidelines allow for honest and transparent discussion among collaborators from the beginning to avoid potential problems. It was Darsee's case that motivated the International Committee of Medical Journal Editors (ICMJE), known as the "Vancouver Group," to develop an explicit authorship criteria during the 1980s to prevent "deceptive authorship and dilution of responsibility within multi-author papers" and promote authorship ethics (Bennett and Taylor, 2003). Originally developed for biomedical research, these guidelines have been adopted by other disciplines with suitable modifications. An author, accordingly, should fulfill all of the following four criteria provided verbatim below (ICMJE, 2017):

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work
2. Drafting the work or revising it critically for important intellectual content
3. Final approval of the version to be published
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

These guidelines serve as a constant reminder that anyone who has made substantive intellectual contributions deserves to be an author and that all listed authors take full responsibility and accountability for the published material. Given the potential for abuse and deception, many journals have stringent policies and require specific information regarding the nature of contributions made by individual authors listed in the publication. Universities and research organizations have also developed their own authorship criteria in response to misconduct cases. The Office of the Vice Chancellor for Research of Washington University in St. Louis offers useful suggestions and enhances the ICMJE's authorship criteria and clarifies that "administrative relationship, acquisition of funding, collection of data, or general supervision of a research group alone does not constitute authorship" (Washington University, 2009).

In the case of publications with multiple authors, the "lead author" assumes overall responsibility for the preparation of the manuscript in addition to contributing significantly to the research effort and maintains liaison with the publisher or journal editor. Most guidelines make it amply clear that being a principal investigator or project leader or head of a department/institute alone does not merit lead or coauthorship and requires everyone to fulfill the authorship criteria. However, various unethical authorship practices and the culture it spawns continue to plague academic and research environments. In particular, "guest, gift, and ghost"

authorships are clearly unacceptable and inconsistent with the definition of what constitutes authorship. Strange (2008) provides a useful and more comprehensive list of various types of authorship abuse such as “coercion authorship, guest authorship, gift authorship, mutual support authorship, duplication authorship, ghost authorship, and denial of authorship.”

Of these, guest and gift authorship practices are the most common in various settings. While guest authorships are typically granted to individuals out of respect or courtesy or in the belief that it will increase the chances of publication and credibility of the work, gift authorships are offered to individuals who have not contributed to the work in any significant measure to merit inclusion but done to curry favors or to display a sense of “obligation, tribute, or dependence.” Salita (2010) cites a survey in *Lancet* that showed 32% of scientists were willing to provide guest or gift authorship to increase their paper’s chances of publication or boost their careers. The American sociologist of science Robert Merton attributed this behavior to what he called as the “Mathew Effect” (Merton, 1968), inspired from a verse in the Gospel of St. Mathew: “For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath.” The junior researchers obviously fall in the latter category. Accordingly, irrespective of the ordering of author names in a multi-authored paper, the most famous author will be remembered. This practice disproportionately allocates credit to the well-known author at the cost of those who may have actually done the work. In a strongly worded editorial in *Science*, Greenland and Fontanarosa (2012) deplored the culture of both guest and gift authorships, which was apparently noticed in 25% of research reports, 15% of review articles, and 11% of editorials published in six major medical journals in 2008, and made a clarion call to end this practice.

There have been many instances of well-known researchers landing in embarrassing situations when fraudulent publications appear with their name. When faced with such circumstances, the typical response of an established senior researcher has invariably been to put the onus of responsibility on the junior author(s) for any research misconduct. The practice of guest and gift authorships is even more widespread in India than the reported figures elsewhere and it is difficult to identify a true author in many multi-authored journal articles. In most situations there is an “ulterior motive” in gifting authorship such as job security, promotions, and support for research funding, travel or fellowships (Ganatra, 1996). A gift authorship is essentially a “bribe” given to people in positions of power by a person who depends on continued patronage rather than relying on his/her capabilities. But the specious reasoning for inclusion of a senior author or head of the institution is the supposed guidance and mentoring involved.

Ghost authorship, on the other hand, is failure to include an author who made substantial contributions to the research or writing of a manuscript and fulfils the authorship criteria. This category of authors range from professional writers hired with the understanding that they will not be credited in the published work to qualified researchers working in private biomedical or pharmaceutical companies who may present evidence to suit corporate interests under the guise of academic researchers. Hiring professional writers is not unethical even in academic settings as long as they are clearly identified. It is common for professional schools (e.g. law, medicine, public policy) to hire case writers to develop teaching materials. Professional writers or consultants are frequently engaged by corporate clients to produce

consultancy reports and other in-house publications. But hiring writers for producing research papers and reports in academic or research settings is considered a deplorable practice similar to a student hiring someone to write term papers or dissertations (Borenstein and Shamoo, 2015). Services of professional writers are now easily available but monitoring, let alone preventing, its illegitimate use is very difficult. A professional ghostwriter confessed about the improprieties involved in ghostwriting and said that the only ethics he maintains is deny his services to healthcare professionals and students (Singh and Remenyi, 2016).

A recent report by a consortium of academies and professional societies expressed concern about the proliferation of unethical authorship practices and concluded that they “undermine the standards of research and distort the allocation of credit” (Inter Academy Council, 2012). The Elsevier’s guide to authorship is unequivocal on this issue and says that guest, gift and ghost authorships are unethical (Elsevier, 2017). In some research areas such as biomedical research and high-energy physics, the scale and complexity of certain research problems may entail several skills and large teams of researchers and technicians cooperating from different institutions and countries. Although apportioning credit can be difficult in such projects, it is argued the entire team members should be credited with authorship. For example, Elwood (2013) cites a paper in a 1993 issue of the *New England Journal of Medicine* that had 972 authors listed in a report that was based on a clinical trial performed in 1,081 hospitals across 15 different countries and involving 41,021 patients. Another article in a 2008 issue of the *Journal of Instrumentation* had a description of the Large Hadron Collider, which required 32 pages to list the 2,926 authors and their affiliations. More recently, a physics paper which formally announced the mass estimate of the Higgs boson, had 5,154 authors and broke the previous record (Castelvecchi, 2015).

Determining the degree of involvement of each individual author listed in such papers and the order in which they should be listed can be problematic. Suppose if authors of a fraudulent multi-author paper claim that the problematic portions of a discredited paper was not their responsibility and hence should not be held accountable, it will not fly because all authors will be held equally accountable according to most authorship criteria. To avoid such problems, some journals recommend distinguishing an “author” from a “contributor” so only the listed authors take full responsibility and accountability to the reported results. In such situations, the 2012 Inter Academy Council report advises authors of multi-authored publications to take the help of a trusted colleague to check for the content’s accuracy and integrity (Inter Academy Council, 2012). It is “irresponsible authorship rather than multiple authorship” that poses the real challenge (Sigma Xi, 2000). It is still possible for authors in a multi-authored paper to fulfil the authorship criteria without standing accused as an unmerited author. The two cases of Schoen and Ninov, for example, initiated reforms in the physical sciences when the American Physical Society (APS) issued detailed guidelines on authorship to prevent the situation where coauthors could be completely in the dark when fabrication or falsification happens under their nose (Dalton, 2002). The new APS guidelines insist that all coauthors be “accountable for the integrity of critical data” and assume full responsibility for all contents of a published paper.

Other forms of authorship abuse include “mutual support authorship, duplication authorship, and denial of authorship” (Strange, 2008). In a mutual support authorship, two or more



investigators reward authorship to each other to increase their respective individual publication count conveying the impression as if they were sole authors for purposes of evaluation of their productivity. Dyck (2013) warns that those evaluating research output and performance should be mindful of whether authorship criteria is fulfilled in each case to prevent the researchers from “gaming the system.” Duplication authorship is a common problem where authors publish identical work with some modifications in multiple journals. This recycling of work is somewhat condoned in many institutions. Another variant of this abuse is “salami-slicing” to break up a single work into smaller units of publishable articles. Denial of authorship is a problem that afflicts mostly researchers in the lowest order of hierarchy like students, research assistants and others. Particularly in India, where these foot soldiers do the heavy lifting in terms of conducting fieldwork, preparing first draft and other critical elements, they are, barring some exceptions, denied authorship in most reports. Authorship manipulation, republishing portions of already published material without attribution, and selective citation intended to support one’s own research findings or to please editors, reviewers, or colleagues are considered undesirable (All European Academies, 2017). Unmerited authorship is also attributed to lack of familiarity about the authorship criteria. A 1995 Dutch study based on a sample of 352 authors showed that around 36% of them did not meet the ICMJE criteria and close to 60% was not familiar with the proper guidelines for authorship (Faoite, 2010).

## **“White Bull” or Director Effect**

For many researchers in Asian countries subservience to authority is a deeply rooted trait and comes naturally, which provides enormous scope for various forms of authorship abuse and predation. In Asia one frequently observes that some senior researchers in academia and research organizations expect a tributary relationship with their students and junior colleagues. It is not uncommon for Japanese and Indonesian authors in science and engineering to add their lab directors as a coauthor (Salita, 2010). This culture produces a vicious cycle of “authorship parasitism” when junior scientists indulge in the same abuse they were subjected to earlier as rise up the career ladder. Widespread authorship frauds and abuses are common in China because of the high incentives given for publications (Hvistendahl, 2013), but the Chinese government has woken up to the menace and initiated a slew of measures as it threatens to even discredit genuine work and the credibility of institutions.

Among the various unethical authorship practices the one that is least discussed and most difficult to detect is pressured or coerced authorship. Some of the honorary authorships discussed earlier could result from pressure or coercion where a senior person (eg. Department Head or Director) expects authorship without making any significant contribution to merit authorship. In this type of authorship the impetus to add an undeserving author comes not from the legitimate author but the same undeserving author (Feaser and Simon, 2008). The coercion or pressure may be explicit or implicit depending on the environment. While the actual modus operandi may differ from individual to individual, those demanding authorship use their position of power to assert that any article (in which the perpetrator has interest) that originates from their department or lab should have their name on it. This is particularly the case in organizations with a strong hierarchical work culture. Shen (2016) summarizes

that “a common feature of the various rules of different research groups is that power and authority are hierarchically distributed, the higher the researcher’s status in the group, the greater power he or she has in making decisions and interpreting or even changing the rules concerning authorship.”

Greenland and Fontanarosa (2012) condemned, in their 2012 *Nature* editorial, that such behavior is fraudulent and damages the “ethical culture that is central to a healthy academic environment.” Vain researchers with a penchant for publications, in extreme cases, use their position of power to build a tributary network of willing and vulnerable colleagues to boost their research productivity without doing much work on their own. In a public lecture “A Survey of Academic Ethics” at the Indian Institute of Science on June 23, 2017, Sunil Mukhi, a senior faculty at the Indian Institute of Science Education and Research (IISER) in Pune as well as Chairman of the Committee on Scientific Values at the Indian Academy of Sciences, alluded to this as the “Director Effect” and compared it in a lighter vein to “Divine Command Theory,” a view that all ethical norms is dependent on God and individual morality is complete obedience to God’s commands (Internet Encyclopedia of Philosophy, 2017).

Kwok (2005) describes this extreme type of authorship abuse by researchers holding leadership positions in academia or research institutions as the “White Bull Effect.” The metaphor is loosely based on Greek mythology in which the highly promiscuous Zeus employs the guise of a white bull to seduce Europa. The White Bull is driven by greed and attracted to the rewards of authorship misconduct and uses his position of power to exploit the ambiguities in authorship guidelines and flourishes in poorly regulated and opaque environments at little personal risk. Even if the White Bull nominally satisfies the authorship criteria, he is only superficially involved in the actual research and writing of a paper. Whether such token contribution merits authorship is a tangled thicket to establish. According to Kwok (2005), the White Bull displays distinct personality traits and his motivation for authorship misconduct are due to one or more of the following: “increasing expectations and need to publish; personal ambition, vanity, and the desire for fame; laziness; greed linked to direct financial gain; mental illness; a messianic complex, and the lack of moral capacity to distinguish right from wrong.”

In a 2016 *Current Science* editorial Sunil Mukhi observed thus: “The unfortunate truth is that there have been notable cases of academically unethical practices at high levels in India, including guest authorship and plagiarism, as well as conflicts of interests involving friends, relatives, funding agencies and private companies. These violations, more than any occasional slipshod act of plagiarism by a young student, severely damage the ethical environment and thereby the credibility of Indian science” (Mukhi 2016).

While unethical authorship practices are widespread, authorship misconduct involving people holding positions of power is largely anecdotal and difficult to establish in the absence of credible information from within the organization. Nonetheless, some egregious cases of authorship misconduct can now be detected with the advent of large databases of peer reviewed literature like Elsevier Scopus or Web of Science. These databases catalogue a significant fraction of the global output of research through journals, conference proceedings and book series. The long time series and near-universal coverage of a person’s publication record along

with openly available information such as a person’s professional history, designations and positions in academia and research laboratories can be used to detect a pattern in authorship and construct plausible cases of authorship misconduct.

We report here a spectacular case of plausible authorship misconduct of a well-known scientist administrator Baldev Raj. Raj is the former Director of the Indira Gandhi Centre for Atomic Research (IGCAR) at Kalpakkam, a Department of Atomic Energy (DAE) lab working on breeder reactor research and development, and presently Director of the National Institute of Advanced Studies (NIAS) in Bengaluru, a preeminent national institution established by the late J.R.D. Tata in 1988 and partially supported by the Tata Trusts to foster multidisciplinary research and training in India. In February 2017 Raj was appointed by Prime Minister Narendra Modi as the Chancellor and Chairperson of the Board of Governors of the Academy of Scientific and Innovative Research (AcSIR), which is a deemed university set up by an Act of Parliament as an “Institute of National Importance.” AcSIR is an umbrella organization comprising various CSIR laboratories and institutions.

Raj has a prolific publication record of 714 Scopus tracked peer reviewed works and more than 1300 publications according to his recent curriculum vitae (NIAS, 2017). The summary of our investigation using data from Scopus is depicted in Figure 1. It clearly shows that Raj’s publication record is exceptional and remarkably different from other directors of BARC and IGCAR, the two largest DAE research laboratories. His publication record in the DAE pantheon is singular and remains unbroken. Even now Raj manages to churn out publications at a rate that is unmatched by any NIAS faculty member or any of the past Directors, sometimes in areas beyond his known expertise. A well-known scholar and a recent visitor at NIAS said that he was amazed to find Raj coauthoring so many working papers and articles and commented with his tongue in cheek that “he must be spending most of his time mentoring colleagues!”

Figure 1 provides both powerful and prima facie evidence for plausible authorship misconduct throughout much of his career at IGCAR. In 2011, the last year of his tenure as Director of IGCAR, Raj’s research productivity peaked at 77 publications (one every 4.7 days). Raj’s tenure as IGCAR Director (2004-2011) represent the *anni mirabiles* of his publishing history during which he authored 388 of his 714 Scopus tracked articles, which represent 54% of his lifetime research output. He was the Director of the Materials and Metallurgy Group (MMG), IGCAR in the period 1993-2004 and also held the position of the Director of the Chemicals and Reprocessing Group (CRG), IGCAR during the period 1999-2004 (NIAS, 2017). In the period 1999-2003, Raj authored another 110 publications. Table 1 shows the average productivity of Raj in different periods relative to his tenure.

Raj's Publication Record Compared to Other DAE Laboratory Directors

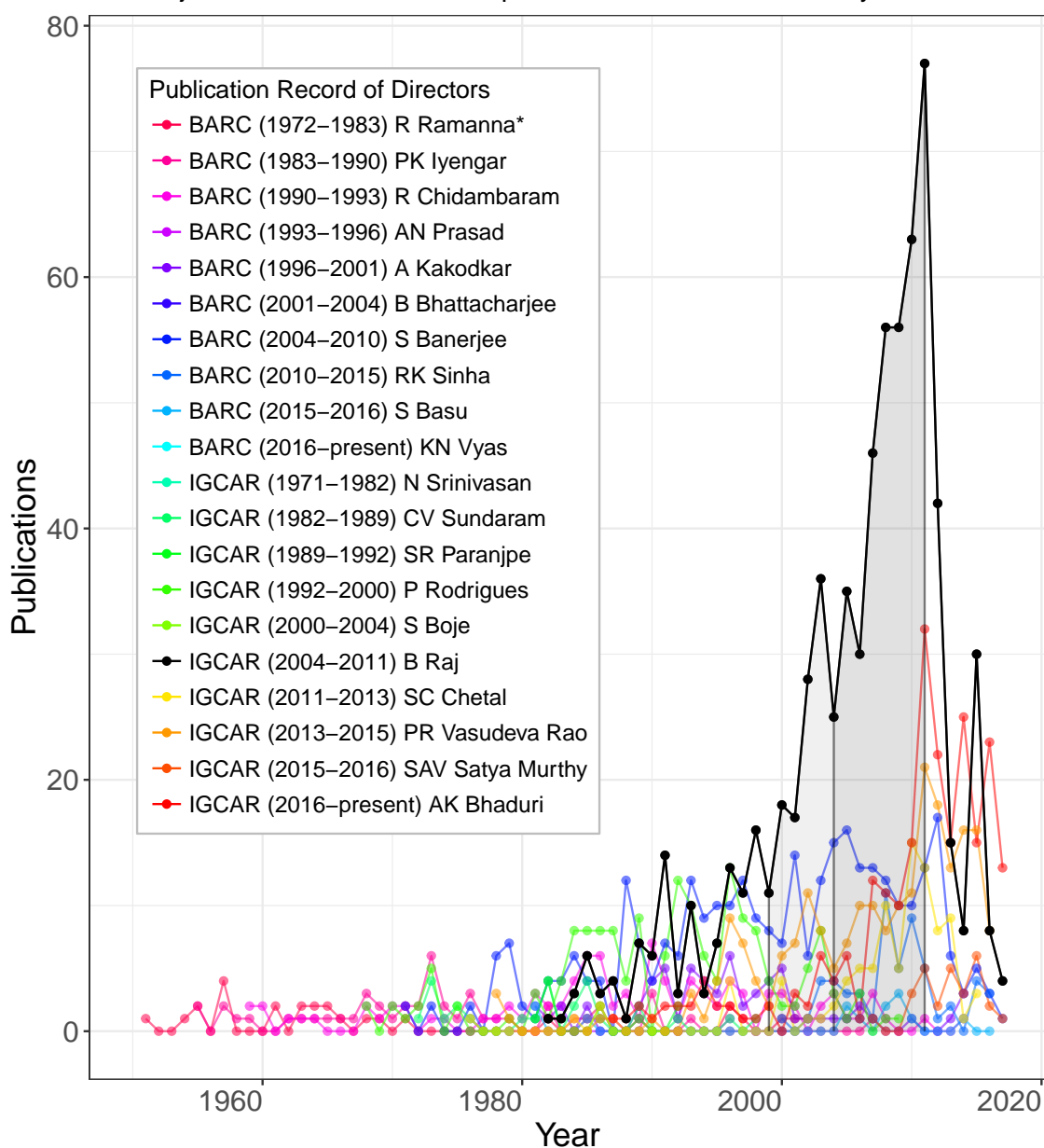


Figure 1: Publication history of BARC and IGCAR directors (post 1970) as tracked by Scopus. Note the exceptional publication record of Baldev Raj when compared to all BARC and IGCAR directors post 1970 tracked by Scopus. We highlight Raj's directorship years (2004-2011) and the five years (1999-2003) preceding it. The publication record peaks at 77 entries in 2011, the average through his tenure is an impressive 48.5 per year. (\*Note that Raja Ramanna's tenure includes a break from 1978-80 when S. Fariduddin was the Additional Director). Source: Scopus

Table 1: Baldev Raj’s productivity growth

Time period	Average annual productivity
1993-1998 (Dir., MMG, IGCAR)	10
1999-2003 (Dir., MMG and CRG*, IGCAR)	22
2004-2008 (first 5 years as Dir., IGCAR)	38
2007-2011 (last 5 years as Dir., IGCAR)	60
2011 (last year as Dir., IGCAR)	77

\* (MMG, Materials and Metallurgy Group; CRG, Chemicals and Reprocessing Group)

Different fields of research have different rates of publishing output. For example, it would be natural to expect experimental fields like metallurgy, material science and chemistry to have substantially higher productivity than nuclear engineering or physics. Indeed, BARC and IGCAR Directors with material science and chemistry backgrounds have higher productivity. In Figure 2, we compare a select sample of these Directors who averaged at least 5 papers per year in the five year period (D-6, D-10), where D refers to the year they were appointed as Director.

Starting from a fairly high average productivity of 10 publications per year in the period 1993-98, Raj increased his productivity by a factor of almost 8 to an unbelievable figure of 77 publications in the last year of his tenure as director in 2011. These numbers do not include many non-indexed articles, technical reports, internal reports and other documents from IGCAR and other institutions that will likely have him as an author. Early detection of some of the notorious cases of scientific misconduct in the United States and China were initially triggered by inflated publication count of researchers. In the Robert Slutsky case (described earlier in Section 2), where during a two year period he was an author on one article every 10 days, those investigated the case said that such “unreasonably high productivity” should have alerted his colleagues much earlier (Bernstein, 1986).

This analysis suggests a pattern of authorship abuse and misconduct for a long time. Our conversations with Raj’s current and former coauthors from various institutions provide corroborative and anecdotal support for our hypothesis of plausible authorship abuse and misconduct. In this analysis we have not examined other types of research misconduct such as fabrication, falsification, and plagiarism.

Raj's Productivity Compared to Other Highly Productive DAE Lab. Directors.

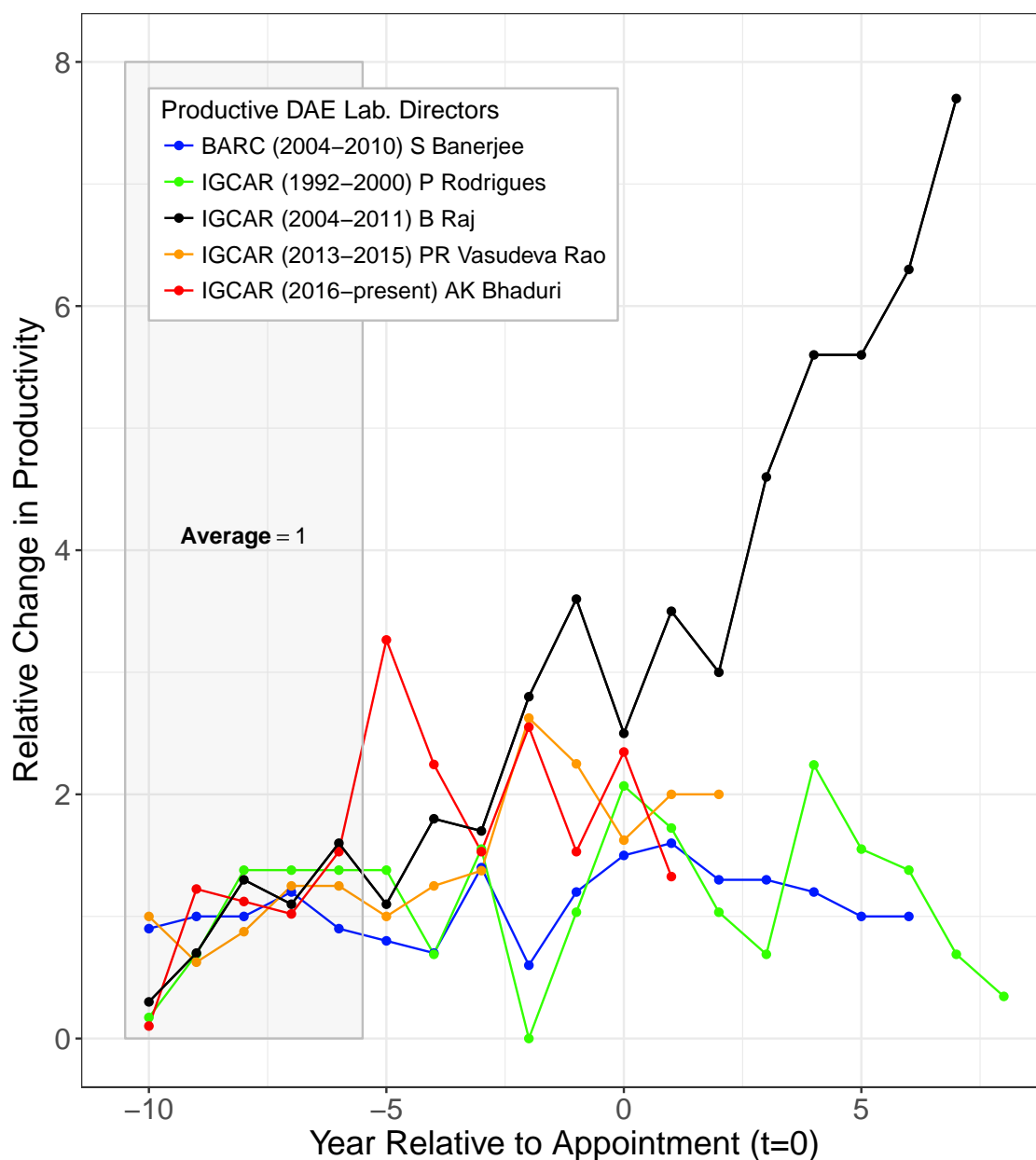


Figure 2: Plot of productivity normalized by the average number of papers in the five year period (D-6, D-10), where D is the year of the start of tenure as Director. This plot also shows that the remarkable increase in authorship of Raj during his tenure as Director and in the five years preceding it. The productivity increases nearly eightfold from 10 publication per year to peak at 77 in the last year of his tenure. Raj's productivity stands out compared to other highly productive Directors from similar Material Science and Chemistry backgrounds.

## Dealing with Research Misconduct

While there is a broad consensus that research integrity can be preserved only through strict observance of ethics and norms, there is a general lack of willingness in the research community to face up to research misconduct. A 2012 *Nature* editorial, commenting on this stark reality, said “many people in science would rather not talk about the problem of research misconduct, much less act on it” (Nature, 2012). Research misconduct allegations and investigations generate lot of unpleasantness for everyone involved besides exposing the institution to embarrassing media coverage and potential lawsuits. But the process of going through a purgatory is an essential part of institutional rejuvenation. If anything, institutions have only gained trust and reputation when they credibly act on misconduct allegations instead of hushing it up. In 2005 MIT received widespread commendation for handling the Luk van Parijs case with alacrity (Brumfiel, 2007). When Parijs’ colleagues reported to concerned authorities about his suspected research misconduct, MIT moved quickly to determine the need for investigation, conducted it, maintained strict confidentiality of the complaints, found him guilty of fabricating and falsifying data, and immediately fired him from the faculty position.

Detecting and investigating research misconduct is not easy because the process of evaluating research largely operates on the basis of trust. There is an implicit social contract among the researchers that honesty and integrity will be upheld throughout the process of conducting and reporting research. Journal publication and peer review process are not designed to detect willful violation of this implicit contract. They are in place to primarily check for the originality of the reported work and identify and correct potential errors. Peer review is also not uniform in terms of rigor and standards. While the top journals act as gatekeepers to control quality in the respective fields, most of the reported misconduct cases also pertain to works published in those journals. This is because the quality of peer review is relatively higher to detect potential misconduct cases compared to lower-tiered journals. The limitations of the current peer review were revealed when *Science* decided to test the effectiveness of the system by sending a concocted paper to over 300 open-access journals (Bohannon, 2013). The result of this sting operation was quite alarming as more than 50% of the journals accepted the fake manuscript as worthy of publication.

There are various mechanisms available to detect and investigate fabrication, falsification, and plagiarism cases. Plagiarism is easier to detect because the entire process has been automated with the digitization of most published work and requires minimal human effort and value judgment. Hence it is not surprising that many predatory journals and vanity publications do not subject submissions through plagiarism checks. Many universities now require students to ensure that they do not submit work (term papers for course work, research proposals, and thesis) containing plagiarized material.

However, detecting fabrication and falsification is harder. Unless a work generates significant interest in the field, fabrication and falsification cases can remain undetected for long in the absence of intrepid whistleblowers to unmask such cases. Bouter (2015) reports from a survey that around “2% of the researchers admitted to having falsified or fabricated data at least once, and 34% admitted to having been guilty of questionable research practices at

least once.” However, when asked about their colleagues, they reported significantly higher figures of 14% and 72%. Farthing (2014) cites another survey which estimates the incidence of serious misconduct between 0.3% and 0.8% while the instances of other unethical practices range from 5 to 15%.

Unethical authorship is often the most difficult type of research misconduct to detect. In some cases coauthors are complicit, while in others, there is a fear of speaking up in the absence of institutional mechanisms to credibly and transparently address such complaints. Even in countries having clear guidelines and statutory bodies to deal with research misconduct, there is a lack of mechanism to resolve authorship disputes. There is usually a conspiracy of silence surrounding authorship misconduct, especially if important members of the research community are involved. In the absence of a national policy and statutory body to deal with research misconduct and unethical authorship, in India the issue is entirely left to individual institutions to address such cases. The Society for Scientific Values (SSV) in New Delhi was set up as a private nonprofit entity in 1986 with no legal or administrative powers but has significant credibility in the eyes of the peer community and comes closest to the Office of Research Integrity in the United States (SSV, 2017; Office of Research Integrity, 2017). While the ORI is a statutory body with a clear set of guidelines and resources, the SSV is a voluntary operation comprising mostly retired academics and has taken up misconduct cases that were formally brought to its notice.

A search for research ethics and misconduct policies in the websites of many preeminent institutions in the country such as IISc and IITs failed to produce any document in electronic form, which is also corroborated by (Mukhi 2016). But some institutions such as the Indian Institute for Science Education and Research (IISER) Pune, National Centre for Biological Sciences (NCBS) Bengaluru, Indian Academy of Sciences (IAS), Department of Biotechnology (DBT), and NIAS Bengaluru have fairly good research ethics documents. Of these institutions, the NIAS Doctoral Programme handbook is the only document which specifically addresses various types of authorship abuse (NIAS, 2016). Neither the culture of ethical research nor the reported incidence of research misconduct in India has reached a level for the research community to come together to produce a national guiding policy document in this regard. In the absence of a national policy document, it is left entirely to some farsighted individuals in institutions like NIAS and IISER Pune to put together guidelines for ethical and responsible conduct in research. Unless the government makes it a priority to evolve a guiding policy document, institutions are unlikely to develop and enforce consistent research ethics and standards. Resnik and Rasmussen et al. (2015) provide a survey of the status of research ethics policies of around 40 major countries in the world (See Table 2 below). This study reveals that beyond fabrication, falsification, and plagiarism, there is significant variation in across countries in recognizing the seriousness of various deviant and questionable research practices. Despite being one of the global leaders in research and development, in terms of total spending, India is a notable exception without a national research ethics policy document that can serve as guidance for researchers across various disciplines. It is imperative that the present government takes initiative to enhance the credibility of research done in India.



Table 2: Status of Research Ethics and Misconduct Policies in the World's Leading Countries (2015)

Country	Policy	R&D Rank	R&D Share of GDP
United States	Yes	1	2.8
China	Yes	2	2
Japan	Yes	3	3.4
Germany	Yes	4	2.9
South Korea	Yes	5	3.6
France	Process*	6	2.3
United Kingdom	Yes	7	1.8
India	No	8	0.9
Russia	No	9	1.5
Brazil	Yes	10	1.3
Canada	Yes	11	1.9
Australia	Yes	12	2.3
Taiwan	Yes	13	2.4
Italy	Process*	14	1.2
Spain	Yes	15	1.3
Netherlands	Yes	16	2.1
Sweden	Yes	17	3.4
Israel	No	18	4.2
Switzerland	Yes	19	2.9
Turkey	No	20	0.9
Austria	Process	21	2.8
Singapore	Yes	22	2.7
Belgium	Process*	23	2
Iran	Yes	24	0.8
Mexico	Process*	25	0.5
Finland	Yes	26	3.5
Poland	Yes	27	0.8
Denmark	Yes	28	2.9
South Africa	No	29	1
Qatar	Process*	30	2.7
Czech Republic	Process*	31	1.8
Argentina	No	32	0.6
Norway	Yes	33	1.7
Malaysia	No	34	0.8
Pakistan	No	35	0.7
Portugal	No	36	1.4
Ireland	Yes	37	1.7
Saudi Arabia	No	38	0.3
Ukraine	Process*	39	0.9
Indonesia	Yes	40	0.2

\* Indicates that a process to formulate national research ethics and misconduct policy is under way.  
Source: David B. Resnik, Lisa M. Rasmussen & Grace E. Kissling (2015) An International Study of Research Misconduct Policies, Accountability in Research, 22:5, 249-266

In the 2013 Henry L Bockus Lecture, Farthing (2014) identified three ways by which misconduct cases see the public light: reported cases of misconduct, research surveys, and retraction rates of published papers. However, these together likely represent only the proverbial “tip of the iceberg” while a large number of cases remain undetected or unreported for various reasons. Whistleblowers, who are essentially insiders and privy to the misconduct, play an important role in unmasking these cases. Lubalin and Matheson (1999) say that it is often a willing insider who comes forward to report such cases who adds “significant value to society and to the integrity of scientific research” even though it can invite retaliation, ostracism, and censure from the larger scientific and research community.

In countries like India, in the absence of a national policy document and credible institutional mechanisms to address research misconduct, whistleblowing is the only means to report misconduct involving influential members of the research community. Even in countries having credible institutional mechanisms for dealing with research misconduct, whistleblower protection is frequently emphasized. More recently, Australia has enacted legislative protection for whistleblowers in their national research ethics policy “Code for the Responsible Conduct of Research” which will be handled by the Australian Research Integrity Committee (Breen, 2016). Besides whistleblowers, protection for informants during the process of misconduct investigations is equally important (OSTP, 2017). With whistleblower protection in place, the US National Academy of Sciences asserts that individual scientists have an “obligation to act” when they encounter suspected research misconduct and report to concerned authorities (Titus and Wells et al., 2008).

While all these measures go a long way in deterring research misconduct, good institutional culture and ethics training in education and during research apprenticeship are more important means to inculcate ethical conduct in research. The US Department of Health and Human Services policy document insists that “research integrity is best fostered by developing and disseminating clear standards of behavior in science (whether by professional organizations or by research institutions or both), and by reinforcing those standards through education and example at all stages of scientific development, and at all levels of research administration” (USDHHS, 1995). In this context, senior researchers have a special responsibility in creating and sustaining the right institutional culture and imparting good ethical practices to their students and junior colleagues. In a 2012 editorial in *Science*, Greenland and Fontanarosa (2012) suggest that senior researchers should serve as “role models” for their junior colleagues on ethical authorship practices and reminded that it their “duty” to take a collective stand against coercive authorship practices in their institutions and support colleagues refusing to comply with such predatory behavior. Most importantly, it is incumbent for any institution that wants to foster high ethical standards and values to have exemplary leadership. According to Titus and Wells et al. (2008), “People imitate the behavior of powerful role models. Institutions successfully stop cheating, for example, when they have leaders who communicate what is acceptable behavior, encourage faculty members and staff to follow the policies, develop fair and appropriate procedures for handling misconduct cases, focus on ways to develop and promote ethical behavior, and provide clear deterrents that are communicated.”

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