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Towards a biblical mind

Integrity in scientific research

A Christian perspective

by Keith R Fox

Summary
Misconduct and a lack of personal integrity is increasingly detected within scientific research, as it is in many other areas of public life. Examples include fraud, data manipulation, bias, conflicts of interest and plagiarism. This can lead to public mistrust of science, as well as being a waste of resources. This paper considers some of the causes of the problem and describes how scientists should follow principles of honesty, humility and truth-seeking, values that are integral to Christian ethics. These principles apply not just to scientific research but to all aspects of human endeavour and our approach to research should be the same as the principles that govern every aspect of Christian behaviour.

'Research carried out with a high level of integrity upholds values of honesty, rigour, transparency and open communication, as well as care and respect for those involved in research and accountability for a positive research environment.' [1]

'Good research should be well adjusted, well-planned, appropriately designed, and ethically approved.' [2]

Introduction

Several recent surveys have shown that as many as 50 per cent of researchers claim to have witnessed research misconduct, while about five per cent admit to having personally engaged in some form of misconduct.[3] One report even claimed that as much as half of the scientific literature may be untrue.[4] The degree of misbehaviour varies from the severe, such as deliberate fraud and 'inventing' or manipulating data, to questions of attribution and authorship, as well as issues of plagiarism, bias, exaggeration and conflicts of interest. Misconduct is probably most common in biomedicine, where the competition and rewards are often greatest, but it can be found in almost all areas of research.[5] Although this paper focuses on science, examples of fraud are known in most disciplines, including humanities, social sciences, music and even ethics.[6]

Science has a role in informing public policy and fraudulent research leads to a public mistrust of science.

Examples of gross fraud in science could include the hoax hominid skull 'Piltdown Man'[7] or the inflated ego of Jan Schön who fraudulently claimed breakthroughs in semiconductor research, winning several international prizes, that were subsequently

1 <https://www.ukri.org/what-we-offer/supporting-healthy-research-and-innovation-culture/research-integrity/>
2 <https://farname-inc.com/post-2/f53d32c/committee-on-publication-ethics-COPE-guidelines-on-good-publication-practice>
3 Nicolas Chevassus-au-Louis, *Fraud in the Lab: The High Stakes of Scientific Research* (Harvard University Press, 2019).
4 R. Horton, 'Offline: What is medicine's 5 sigma?', *Lancet*, 385, (2015), 1380.
5 A list of incidents of scientific misconduct can be found at: <https://en.wikipedia.org/wiki/List_of_scientific_misconduct_incidents>; see also Matt Ridley, 'Science fiction: the crisis in research'. <https://www.spectator.co.uk/article/science-fiction-the-crisis-in-research/>
6 <https://www.youtube.com/watch?v=d2Tm3Yx4HWI>
7 <https://www.nhm.ac.uk/our-science/departments-and-staff/library-and-archives/collections/piltdown-man.html>

rescinded.[8] More recently, fraudulent claims that the MMR vaccine caused autism led to unfounded fears about vaccination and a decrease in its uptake.[9] These extreme examples are eventually resolved as progress in science is self-correcting. However, there are numerous examples of other breaches of academic integrity, which waste time and resources,[10] risking lives when falsified research leads to inappropriate medical treatments. Science has a role in informing public policy and fraudulent research leads to a public mistrust of science. Breaches of scientific integrity appear to be increasing, though it is not clear whether this is due to a greater incidence or to better vigilance. Nonetheless, any breaches of research integrity should be a matter of concern. Given that science is supposed to be about discovering facts about the way that the world works and developing reasonable hypotheses to explain them, we must ask serious questions about why this happens, and address the personal and institutional pressures that foster poor behaviour.

The causes of scientific malpractice

Institutional pressures

Almost all scientific research requires financial support for equipment, consumables and salaries, and there is intense competition for sources of funding. These grants can come from government, from charities or industry. Charities have their own special agendas, which in biomedical research will include topics such as cancer, heart disease and dementia. Research Councils have 'grand challenges' such as ageing, cancer, climate change and food security. In many instances the success rate for grant applications can be 20 per cent or lower, even for research proposals that are judged to be internationally excellent. Funders are often concerned with the beneficial outcomes of research rather than scientific discovery for its own sake. In contrast, many researchers are motivated by a sense of curiosity and a desire to know. This mismatch can lead researchers to shoehorn their specialist research interests into the broader funding streams in attempts to 'follow the funding', and so they may not be totally honest about what they really want to do. So researchers are tempted to hype their proposals, with exaggerated claims about potential outcomes in the drive to attract funding. Funders are unlikely to support highly speculative research and so they require some preliminary data to demonstrate the feasibility of a project. There is then a fine line between providing authentic supporting data and knowing the assured outcomes of the research that has already been substantially completed.

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Research that is supported by commercial interests brings a different series of problems with potential conflicts of interest and issues of confidentiality. A team from Yale University found that studies funded by industry were 3.6 times more likely to have conclusions that were favourable to industry than studies without that support.[11] This need not indicate misreporting or fraud, but may simply be because negative results are less likely to be published, which in itself is a problem that can lead to waste, as failed trials are needlessly repeated by competitors. Researchers may also be pressed to modify the conclusions of a study to satisfy the research funders (sponsorship bias).

Personal pressures

The scramble for research funding is not merely a matter of detached academic interest, but is a challenge for individual researchers whose careers and job security are affected by the ability to attract funds. Many researchers do not have security of tenure; postdoctoral workers are usually employed on three-year contracts and there have been many instances in which so-called 'research inactive' staff have been made redundant. Promotions and career advancement are of course dependent on demonstrating successful research ideas, which will be evidenced by attracting grant funding and publication in high-impact journals. These pressures can lead to temptations to cut corners, exaggerate claims and even fabricate or manipulate results.

Researchers are human and have egos that desire to be the first to make an outstanding discovery. There are no accolades for being second, or for repeating something that has already been done. The race for recognition can produce hurried research that is poorly planned, with insufficient data, or conclusions that are not properly

8 <https://www.theguardian.com/education/2002/sep/18/science.highereducation>
9 F. Godlee, J. Smith and H. Marcovitch, 'Wakefield's article linking MMR vaccine and autism was fraudulent, *British Medical Journal*, 342 (2011), c7452.
10 The UK government's net expenditure on research and development (excluding EU contributions) was £14.0 billion in 2021. <www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/>
11 <https://medicine.yale.edu/news/yale-medicine-magazine/article/does-industry-funding-equal-conflict-of-interest-often/>

discussed. This is probably one of the main factors that lead to data fabrication and fraud. Sometimes we need to slow down! Such fraud seems counter to the concept of truth in science (i.e. discovering how the world really works), yet it happens. Sometimes this is because the researcher is so confident of their research hypothesis that they assume the results before conducting the research, and so find ways to announce the results before obtaining the data. In some instances, data fabrication may not directly alter the overall conclusions of the research, but in many cases it wastes the time and resources of other researchers who are unable to replicate the fabricated data. Presuming on nature in this way is a clear example of human hubris – assuming that we know better than nature itself; presuming how we think the world ought to be, rather than discovering how it is. Researchers can also succumb to confirmation bias, only considering those results that are consistent with their hypotheses and (unintentionally) ignoring conflicting data.

Publish or perish

The competitive search for 'impact' and for publication in so-called 'high-impact' journals, can lead to hurried publication of research that is poorly planned or incomplete. This is compounded by the editorial policies of top journals, which, understandably, only publish work that is novel and sufficiently 'ground-breaking'. This too encourages researchers to exaggerate the importance of their research in order to satisfy the demands of editors and referees. I suspect that it is at this stage in the publication process, when the research is almost ready for acceptance, that the temptation to cheat is at its greatest. The temptation is aggravated in some countries where researchers are offered significant incentives for publishing in high-impact (Western) journals. This has been particularly prevalent in Chinese science, though since 2020 Chinese institutions have been told to stop paying bonuses to researchers for publishing in esteemed journals.[12]

Image manipulation is a common type of scientific misconduct, in which authors can crop, flip, rotate and enhance an image to create fake data, that often look convincing to editors and reviewers. Software is increasingly being used to detect signs of image manipulation, though the problem with screening tools is that fraudsters quickly find workarounds. There is evidence that some researchers may be tempted to use AI to create fake data.[13] This would have catastrophic consequences for scientific integrity. These problems are compounded by so-called 'paper mills', which are profit-oriented, illegal organisations, often operating out of Russia or China, that sell fraudulent manuscripts that resemble genuine research articles.[14] Their use affects the reputation of honest scientists from these countries, making other researchers suspicious of their work, and therefore reluctant to collaborate with them.

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Problems with reproducibility

Science is supposed to be reproducible and self-correcting, yet no one is encouraged to repeat published research and there is no funding for 'me-too' work. Publishers are genuinely concerned about the relatively high proportion of results that cannot be reproduced,[15] a failure that wastes time and resources. Indeed science, like many other disciplines, advances faster when people waste less time pursuing false leads. More than 60 per cent of respondents to the *Nature* survey[16] mentioned the pressure to publish and selective reporting as factors that contributed to problems in reproducibility.

Poor oversight and training

Many senior scientists are remote from the actual research, which is done by skilled graduate students or postdoctoral workers, while the 'principal investigator' may only be involved in the administration and management of science. There are many examples of senior investigators who have unknowingly published false or inadequate results that have been provided by a junior worker, which they did not have sufficient time properly to critique. 'If graduate students train in labs where senior members have little time for their juniors, they may go on to establish their own labs without having a model of how training and mentoring should work'.[17]

Plagiarism and authorship

Copying (i.e. stealing) other people's data or ideas is also widespread, though in some cultures copying others' work is seen as a mark of respect. Translation plagiarism occurs when a research paper is republished in a different language with changes in authorship. 'Gift' or 'ghost' authorship, adding an author who has not contributed to the work, is sometimes used to curry favour with a colleague or to enhance the chances of successful review. This is more frequent in sciences, for which multi-author papers are common. Omitting citations of important background research which has been done by competing laboratories is also a common fault and avoids giving credit where credit is due.

Other types of misconduct

Proper academic integrity also includes personal behaviour and how we treat other people. Do we respect others and

12 S. Mallapaty, 'China bans cash rewards for publishing papers', *Nature*, 579 (2020), 18.
13 <https://www.theregister.com/2023/03/11/ai_scientfic_fraud/>
14 H. Else and R. Van Noorden, 'The fight against fake-paper factories that churn out sham science', *Nature*, 591 (2021), 516–519.
15 M. Baker, '1,500 scientists lift the lid on reproducibility', *Nature*, 533 (2018), 452–454.
16 Ibid.
17 Ibid.

give credit where it is due, rejoicing in other people's discoveries? What about the pressure to work excessive hours to the detriment of any work–life balance? Research isn't the only profession for which there is an attitude that 'any colleague who isn't overworked, stressed out, and overbooked seems like an apathetic or lazy eccentric.'[18] Research leaders should be careful to recognise that laboratory members are fellow humans with other interests and responsibilities, and need time to relax and pursue other things in life.

Scientists who have achieved a public profile can be tempted to speak about areas that are outside their own expertise. In our celebrity culture, people who are successful in one field are often asked to pontificate with authority on very different ones. This is an abuse of a scientist's role. Researchers are entitled to their own opinions, but there are some who use their scientific authority to promote their views on ethical, political or moral questions that are well beyond their own expertise.

How can we prevent breaches of academic integrity?

Few people set out with the intention deliberately to lie, but some become entrapped by a slippery slope of small wrongdoings. 'Nobody arrives at fraud as the first thing they ever do...they got there by doing little things and getting away with it.'[19] So we need to tackle the root causes of the problem. Whistle-blowing or calling-out isn't easy or straightforward, but challenging a colleague's poor practice early will prevent escalation, which could otherwise ruin a promising career. It is helpful to 'speak the truth in love' to nip problems in the bud, and a gentle word in season to a colleague should warn them of impending dangers. The culture of a research group, which is established by its senior leadership, should help to make breaches of integrity unthinkable. Raising issues with institutional integrity officers and asking for independent examination are methods often used by journal editors when they suspect malpractice. However, some institutions may be slow to respond, afraid that the ensuing bad publicity may tarnish their reputation.

There is an industry of 'whistle-blowers', some of whom are genuine seekers after truth while others are troublemakers. Between 500–600 papers are retracted each year (out of about five million research papers that are published annually). Some of these retractions are because of honest errors, but many result from detection of data that has subsequently been shown to have been manipulated, falsified or plagiarised. Publications such as PubPeer and Retraction Watch can be used to record questions about published work, but can lead to unfair 'witch-hunts' if genuine suspicions are subsequently shown to be unfounded. Some topical areas are particularly prone to error and falsification in the rush to get noticed (there have been 360 retractions of COVID-related papers to date).[20]

We need to seek ways to change the culture that surrounds research incentives and find other ways to assess research output than metrics that are based on publications, impact factors and the financial value of grant funding. A very large proportion of grant applications are rated as internationally excellent, but aren't awarded due to lack of funds. For an unsuccessful applicant the system can appear to be a lottery, or they may even suspect that it is corrupt, favouring particular individuals or institutions. If it really is a lottery then maybe some grants should be awarded on that basis. Indeed the British Academy now does this for allocating small research grants (less than £10k) because it attracts so many excellent applications.[21]

The scientific community is increasingly aware of these problems and has responded by changing some of its practices.[22] One recent positive development is that medical trials must now be registered before conducting the research, including details of the aims, hypotheses, research methods and statistical analyses. This facilitates the reporting of negative results and prevents the selective use of data or conclusions that lie beyond the scope of the original objectives. Similarly, the Open Science initiative aims to make all scientific research, especially the original data and resulting publications, accessible for everyone to scrutinise and re-analyse. It might be argued that all research should be repeated by a third party, though in many cases this is not possible because of the complexity, cost or duration of the research, that may only be fully understood by a small number of people with specialist skills and facilities. More realistic could be some form of independent random auditing of research data, with publication of the findings, giving institutions an integrity ranking. We also need to find better ways to publish negative results, thereby avoiding the waste of resources and time when other people repeat the same failed experiments.

We should 'speak the truth, the whole truth and nothing but the truth – so help me God'. Some have suggested that

18 Ibid. Chevassus-au-Louis, p.175.
19 Paul Friedman, quoted in E. Check, 'Sitting in Judgement', *Nature*, 419 (2002), 332–333.
20 <https://retractionwatch.com/retracted-coronavirus-covid-19-papers/> [accessed 19 August 2023].
21 <https://www.thebritishacademy.ac.uk/funding/ba-leverhulme-small-research-grants/>
22 The practice of 'peer review' is often criticised, but it is too big a topic to tackle in this paper. It is not a perfect system, but the author's editorial experience is that it usually works well and it is difficult to improve.

there should be a 'Hippocratic oath' for scientists, whether at the start of a degree, or on the award of a PhD, or on a first faculty appointment. An example could be the Oath of the Scientist[23] which reads:

I earnestly assert that:

- I will apply my scientific skills and principles to benefit society;
- I will continue to practice and support a scientific process that is based on logic, intellectual rigor, personal integrity, and an uncompromising respect for truth;
- I will treat my colleagues' work with respect and objectivity;
- I will convey these scientific principles in my chosen profession, in mentoring, and in public debate;
- I will seek to increase public understanding of the principles of science and its humanitarian goals.

Of course, merely saying these words will have little lasting impact, but they do publicly declare the responsibilities and behaviours that should be expected of researchers.

How should Christians respond?

Historically the values that underpin scientific research (at least in the West) have been derived from Christian perspectives on truth and on the inherent value of the world, which is the work of a good Creator God who has declared it to be good. We therefore have grounds for expecting it to be governed by rational principles, whose logical consistency can be expressed in mathematical form,[24] and which scientists are privileged to explore. The facts of nature are the acts of God; we are merely discovering these facts (as Kepler said, we are 'thinking God's thoughts after Him') and using some of the findings for the benefit of humankind. Any attempt to distort, manipulate or invent data is therefore an act of hubris against the One in whom 'all things hold together' (Colossians 1:17).

Maybe we shouldn't be surprised that all is not well – after all researchers are human too, and they exhibit the full range of aspects of our human nature. Research is practised by people who have the same breadth of emotions and personalities as the rest of humankind. Acknowledging our fallen nature leads us to admit that there is a need for scrutiny and self-examination. In a post-Christian society we can be less confident that the underpinning moral principles, derived from a historical Christian heritage, will be rigorously defended and maintained. Thankfully, there are many scientists who act with integrity who share Christian values of humility, honesty, curiosity and trustworthiness, though they may derive these from other philosophical backgrounds. However, there are a number of Christian values which give theological and philosophical underpinnings that are highly relevant to scientific research by Christians, which go well beyond the purely pragmatic expectation of being able to trust each other.

God has given us the capacity for curiosity and we honour him when we seek to understand the world around us.[25] Good research requires hard work and attention to detail. Christians are called to follow the one who is the truth and that must mean the truthful reporting of our findings, whether or not they support our hypotheses. Truth is more important than personal gain. Humility and honesty are essential Christian characteristics and should especially apply to our approach to research.[26] We stand humbly before the facts and acknowledge that God is the creator and revealer of truth. Our discoveries may be new to humankind, but they have always been known to God.[27] We stand in awe of the wonder of God's creation.[28] One persistent temptation that we face is our pride and the desire to be recognised, for which the antidote is humility.[29] For a Christian, humility is not false modesty or being treated as a doormat, but involves deeds of service to God and others to the best of one's God-given ability. With an attitude of humility, we should 'be more concerned with character than reputation, because your character is what you really are, while your reputation is merely what others think you are'.[30] The essential role of humility in science is acknowledged by secular scientists, who have even suggested that 'science is enforced humility'.[31] The fundamental strength of science is that it compels researchers to confront their own fallibility and to admit that they might be wrong, that our pet theories could be incorrect or that our data are not sufficient to reach any conclusions. However, a recent paper acknowledged that 'although intellectual humility is presented as a widely accepted scientific norm… current research practice does not incentivise intellectual humility.' [32]

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The principles that govern our research should be the same as the ones that affect everything that we do, requiring right habits, virtue and a respect for others. 'Food gained by fraud tastes sweet, but one ends up with a mouth full of gravel' (Proverbs 20:17). As in any profession we should 'work at it with all your heart, as working for the Lord, not for human masters, since you know that you will receive an inheritance from the Lord as a reward. It is the Lord

23 K. Ravid and B. Wolozin, 'The Scientist's Pledge', *Acad. Med.*, 88 (2013), 743.
24 As Einstein said, 'The most incomprehensible thing about the universe is that it is comprehensible.'
25 Ps. 111:2.
26 M. Srokosz, 'Humility: A Neglected Scientific Virtue?', *Science & Christian Belief*, 25 (2013), 101–112.
27 Job 28:1–11; Col. 2:3.
28 Pss. 65:8; 19:1; 8:3–9.
29 Srokosz Ibid; See also John Dickson, *Humilitas: A Lost Key to Life, Love, and Leadership*, (Zondervan, 2007), which traces the Christian roots of humility.
30 J. Wooden and J. Tobin, *They Call Me Coach* (McGraw Hill Professional, 2004).
31 <https://www.theguardian.com/science/blog/2012/nov/13/science-enforced-humility>
32 R. Hoekstra and S. Vazire, 'Aspiring to greater intellectual humility in science', *Nature Human Behaviour*, 5 (2021), 1602–1607.

Christ you are serving' (Colossians 3:23f). Every Christian's primary duty is to God, and this should show itself in the way we approach our everyday lives. No task should be routine or unimportant. Senior researchers should set high personal standards for the planning, conduct and reporting of research. People learn by example and new researchers will inevitably copy the standards and behaviours that are set by their mentors. We must be good examples to others; being accountable to each other and establishing communities of scholars, fostering mutual accountability.

We should be determined to do what is right, even when it is difficult: '... as long as I have life within me, the breath of God in my nostrils, my lips will not say anything wicked, and my tongue will not utter lies… till I die, I will not deny my integrity' (Job 27:3–5).

We also know that our ways are not hidden from the Lord.[33] Integrity is doing the right thing when no one else is looking. As Nobel Laureate Max Perutz said, 'Scientists may not believe in God, but they should be taught why they ought to behave as if they did.'[34] Christian belief acknowledges that someone is indeed watching and we will ultimately be accountable to God. Our actions, motives and behaviours will be exposed in the day of judgement.[35]

A Christian's value before God does not depend on his or her abilities, knowledge or discoveries. Our status does not depend on our cleverness or our discoveries and we acknowledge that our scientific abilities are gifts from God. We are merely discovering what God has done, in our role as stewards of the created order. This assurance should free us from the pressures to find fulfilment in professional recognition. A Christian will acknowledge God's providence, even in unsuccessful grant submissions. This is not an excuse for laziness, or passively to accept poor assessments, but to be assured that God is in control. Being a Christian should free a researcher to resist all these pressures and should release us to collaborate with others in seeking to mitigate them. We need not be envious of the success of colleagues or competitors, neither should we need to manipulate or use other people. 'Do nothing out of selfish ambition or vain conceit. Rather, in humility value others above yourselves, not looking to your own interests but each of you to the interests of the others' (Philippians 2:3).

Conclusions

Although we can have confidence in the outcomes of most published research, as demonstrated by the proven success of many scientific advances, there is increasing evidence of breaches of integrity, which are matters for serious concern. It may not be a new phenomenon, but nonetheless we should be vigilant. Institutional and personal pressures can tempt people to engage in fraud, data manipulation, bias, and plagiarism. Although these do not excuse poor behaviour, we need to do all that we can to acknowledge and minimise these pressures and pray that we will not be led into temptation. Christians should especially act with humility, knowing that we are merely exploring the way that God has ordered the world and that our theories may not stand the test of time. We should humbly celebrate the success of colleagues and competitors. Those who follow the one who claimed to be the truth must faithfully report findings, without bias or prejudice, whether or not they support personal hypotheses. We must be diligent in all that we do, not cutting corners for quick results and rapid publications, but with hard work and attention to detail, ensuring that any conclusions are properly supported by the data.

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33 Jer. 16:17.
34 <www.independent.co.uk/voices/letter-religion-s-role-in-science-1499227.html>
35 E.g. Eccles. 12:13–14; Matt. 12:36; Acts 17:31; Ps. 58:11.

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