

Anatomy of a scientific paper

The purpose of a research article is to present new knowledge in contrast to a review article which aims to make current accepted knowledge known.

In research, it is a requirement that the result must be able to be checked and verified. Therefore, the research article contains accurate information about how the researchers have gone about investigating the problem. The descriptions are so detailed that other researchers can repeat what the original researchers did and, for example, see if they get the same result. This detailed information is to a lesser extent found in a review article.

The language in research articles is becoming increasingly challenging, a study from 2017 shows. Researchers at Karolinska Institute in Sweden have reviewed more than 700 000 abstracts of research articles published in English-language biomedical journals between 1881 and 2015. The trend is clear. The readability of the texts has steadily declined since 1881, according to the study published in *Nature* (<https://www.nature.com/articles/nature.2017.21751>). Therefore, it is important to familiarize yourself with the sections commonly found in research articles.

The structure of a research article

Research articles have largely the same structure, and there are clear rules for which parts a research article should consist of, and which information should be included in the various parts.

Throughout the theoretical description there will be extracts from a prospective cohort study on Monkeypox DNA (<https://www.thelancet.com/action/showPdf?pii=S1473-3099%2822%2900794-0>) to hopefully illustrate and make each section more clear.

Title

The title is the simplest summary of the research work and should be representative of the research work carried out. It is particularly important to include the most important keywords and terms in the title for appropriate retrieval from the search engines and scientific databases.

"Viral dynamics in patients with monkeypox infection: a prospective cohort study in Spain."^[1]

Abstract

This section comes first in the article, and is a summary of the full research paper. A brief summary of the study, design, results and a short conclusion must be given here. There should not be a discussion of the results here. This part of the article is often limited to a certain number of words (200-250). After the abstract, there is often up to 10 keywords that describe what the article is about. These are used in particular by search engines on the Internet, so that the article can be easily found by researchers searching for a mirrored topic. Examples of keywords could be: circulatory system, heart rate, insuline.

The title and abstracts are the only sections of the research paper that are often freely available to the readers on the journal websites, search engines, and in many abstracting agencies/databases, whereas the full paper may attract a payment per view or a fee for downloading the pdf copy.

Introduction

The purpose of this part of an article is to present the background to your study, introduces your topic and aims, and why it is important. Often this part of an article starts with the topic being put into a larger context, for example "Diabetes is an ever-increasing problem among ...". Then, previous research in the area is often presented. In the last part of the introduction, the author problematizes what we do not know today and justifies why it is important that further research is carried out in the very area he/she is researching. Finally, the introduction to an article always ends with a hypothesis to be tested.

"The transmission of monkeypox virus between humans has historically been thought to occur primarily through respiratory droplets. However, during the 2022 clade IIb outbreak, direct contact with infectious material from skin lesions, lesions on mucous membranes, and body fluids occurring during sexual or close intimate contact is believed to constitute the primary mode of transmission." This is a typical example of why this research project is important; Because in this specific outbreak they have reasons to believe that there is a different primary mode of transmission.

Materials and methods

In this section, it must be described in detail how the study has been carried out. As a general rule, this section should be so detailed that other researchers should be able to repeat the study precisely. Here, it must be described how many participants, how old they are, how tall they are, what their blood pressure is, what their cholesterol level is, if they smoke or if they use other medication. In short, everything that can have an impact on the results. Furthermore, all measuring devices must be described in detail: type, model, place of manufacturing etc. Include the exact description of how the experiments have been carried out, how the results have been processed and which statistical methods have been used.

"Data collected included information on the number and location of monkeypox lesions, the presence of systemic symptoms, lymphadenopathies, and proctitis. Physical examination and diagnostic testing (by quantitative PCR [qPCR]) for monkeypox virus were performed on day 0 by a sexually transmitted infection (STI) specialist."

Results

In this part of the article, the results will be presented. Only result from measurements that are accurately described in the method section of the article should be presented. It is often better to present results in figures instead of in text form. There should be no discussion or explanation in this part of the article.

"We found that skin lesions had the longest median time to viral clearance from symptom onset: 25 days (95% CI 23–28). The corresponding value for the other body locations were as follows: 16 days (13–19) for oropharyngeal samples, 16 days (13–23) for rectal samples, 13 days (9–18) for semen samples, and 1 day (0–5) for blood samples." The results in the cohort study are presented both with text and figures. It fits the theoretical description of what this section of the research paper should contain.

Discussion

This section usually start by telling what is the most important finding in the study. The findings must then be discussed against what previous research finds, if there are other comparable articles, as well as placed in the larger context. It should be explained what consequences the results will have in practice. In this section, one should also discuss the uncertainties in the findings.

Acknowledgments

Here everyone who has contributed to the experiments, but is not on the list of authors must be mentioned. It can be technicians, statisticians, nurses or assistants who have had responsibility for part of the study, but not enough to qualify as an author. The person who funded the study must also be thanked (research council, association, etc.)

"The study was funded by emergency response funds of the University Hospital Germans Trias i Pujol and the YoMeCorono crowdfunding campaign. We thank Gerard CarotSans for editing the final draft and Roser Escrig for medical writing assistance with the study documentation. We also thank Laia Bertran, Sergi Gavilan, and Miquel Angel Rodríguez for the operational and financial management of the project..."

References

In this section, details of the in-text citations which have been used in the main text are listed. It will include information such as author, year of publication, title, and publisher or URL. It is necessary because it allows the reader to find the text easily. The works in a reference section should be listed in *alphabetical order*, in other words from A-Z.

Types of scientific text

- Plain research article
- Case report. The case report is a research design where an unexpected or novel occurrence is described in a detailed report of findings, clinical course, and prognosis of an individual patient.
- International study report

- Review. Research review articles provide a critical and comprehensive analysis of existing research on a specific topic. Examples are meta-analyses, systematic reviews and literature reviews. Unlike original research papers, these are considered secondary research because the author is discussing other researchers' work.
- Letter to the editor. A Letter to the Editor is a formal comprehensive letter, addressed to the Editor of a certain publication/magazine/newspaper with the intent of complementing, critiquing, informing, or communicating a certain piece of information.
- Commentary/editorial. A commentary is a comment on a newly published article. A commentary may be invited to the chief editor or spontaneously submitted.
- Reply to published work.
- Errata, retractions. An erratum (pl. errata) refers to a correction of a significant error or additional text within an earlier published article. Journals may retract or withdraw articles based on information from their authors, academic or institutional sponsor, editor or publisher, because of pervasive error or unsubstantiated or irreproducible data.[1] (<https://www.nlm.nih.gov/bsd/policy/errata.html>)

Frauds in scientific research

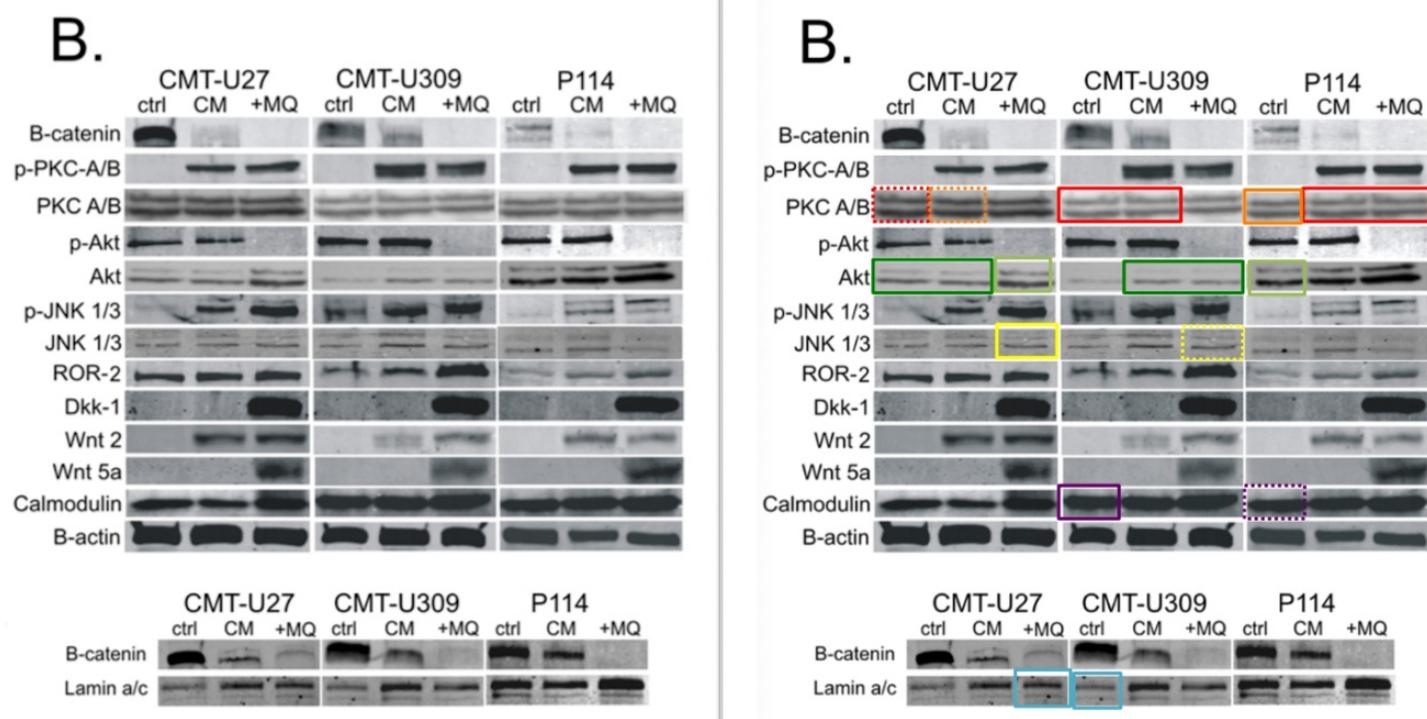
In school textbooks, the facts, laws and theories of the natural sciences are often presented as if they were eternal truths, and science is presented as objective and neutral. On the other hand, outright bluff, cheating and deception happen. The main point is that research is a human activity, and that is of course reflected in it, for better or for worse.

The consequences that research conduct can have are many and potentially disastrous. Firstly, the misconduct can irreparably erode trust among colleagues. It can possibly erode trust between the researchers and funding agencies, which may make it even more difficult for colleagues at the same institution to receive grants. Most importantly, research misconduct can cause the public to lose confidence in the ability and integrity of researchers.

There is a great range of possible reasons for why scientific misconduct occur. It can be due to career and funding pressures, institutional failures of oversight, commercial conflicts of interest, inadequate training etc. If more reliable knowledge about the causes of misconduct can be attained, including the likely role of environmental factors, the research enterprise and people involved will be able to use this knowledge to refine their approaches to preventing misconduct. In addition, it may increase the likelihood of discovering and addressing misconduct after it has occurred.

P-hacking, HARKing, and Science's Replication Crisis

In accordance with U.S. federal policy, there are three forms of research misconduct: plagiarism, fabrication, and falsification.[2] (<https://rcr.gatech.edu/research-misconduct>) Eric Poehlman, an American medical researcher, fabricated data in as many as 10 articles in 1992 and spanning over a decade. He falsified this data on \$3.9 million in federal research funds.[3] (<https://www.science.org/content/article/poehlman-sentenced-1-year-prison>) He published research alleging hormone replacement injections as a therapy for menopause, when in fact they had no proven medical benefits at all. He was sentenced to a year and a day in federal prison.



- P-hacking is the inappropriate manipulation of data analysis to enable a favored result to be presented as statistically significant.[4] (<https://academic.oup.com/book/41543/chapter-abstract/352994794?redirectedFrom=fulltext>) P-hacking has particularly harmful effects because it can be very difficult to detect. With a plausible explanation for why the 'hypothesis' was proposed, results generated by torturing the data in this way are unethical research practices.
- HARKing stands for Hypothesis After Results is Known. The researchers generate a hypothesis after they have analyzed their hypothesis. The purpose of the data collection is usually to test a hypothesis, which indicates that such a hypothesis has to exist prior to conducting the research.

These are two issues contributing to the replication crisis because replicating such research often proves impossible.

1. [https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(22\)00794-0/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(22)00794-0/fulltext)