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How to write an honest but effective abstract for scientific papers

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ABSTRACT

Due to lack of training in scientific writing and sometimes unethical practices, abstracts are often poorly written, lack critical information, and sometimes contain spin. An effective abstract provides brief but adequate information on the purpose, procedure, results and implications of a study. This paper discusses the key components of a good abstract, offers recommendations on reducing spin in abstracts, and analyzes three abstracts written by the author with the goal of helping young researchers write honest and effective abstracts.

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Introduction

Scientific African is a multidisciplinary journal that provides a platform for the cutting-edge research from the African continent. The goal of *Scientific African* is to be a regional journal with a global impact showcasing excellent science through publication of high-quality research. However, the attainment of research excellence in Africa is often hindered by insufficient research support, lack of mentorship, and poor research infrastructure [4]. Hence, our editorial team is committed to promotion of research excellence by helping African researchers improve their scientific writing skills and experimental design.

The publication of research papers in peer-reviewed journals is important for timely and trustworthy dissemination of data. We engage in scientific research to advance knowledge or present solutions to problems. Publishing a research paper is simply a means to attaining this goal, it is not the goal. For that reason, researchers should ensure that their research papers are read by other researchers and policymakers. Most people read the abstract of a research paper before deciding on whether they should invest their time reading the whole paper. Hence, it is important for researchers to make sure the abstract is an accessible and honest snapshot of the whole research paper. A good abstract is like a traffic sign on the edge of a busy highway; easy to see even in the chaos of a rush hour, easy to understand, and accurate (Fig. 1).

Anatomy of an effective abstract

In addition to being clear and brief (preferably less than 250 words), a good abstract has four critical components; (i) a brief background that presence the problem the research paper is addressing, the state of science, and the purpose of study, (ii) a brief experimental procedure that shows the exactly reader what the authors did to address the problem, (iii)

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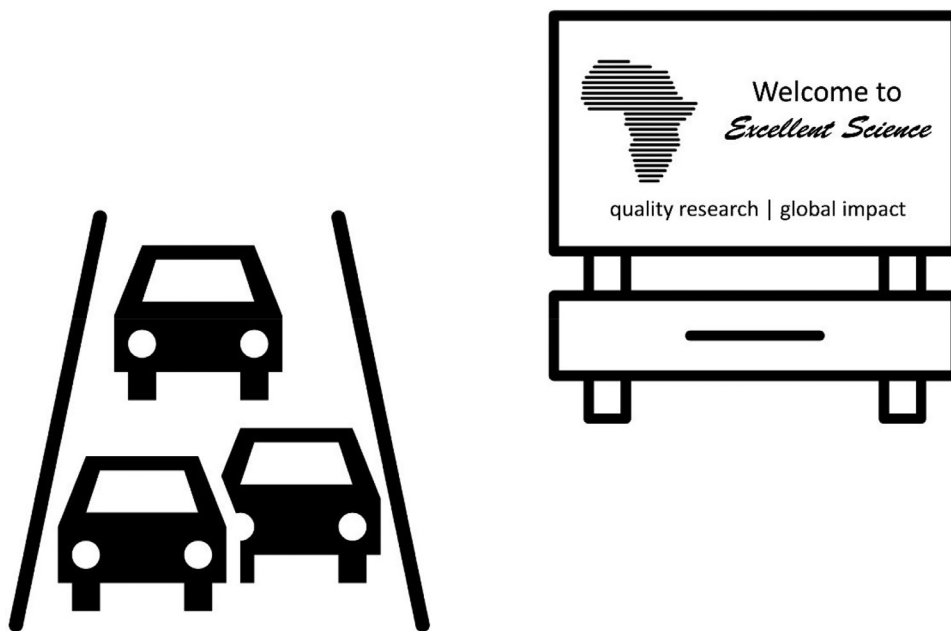


Fig. 1. A good abstract is like a road sign that clearly and accurately shows what lies ahead.

the principal results that shows what the authors found in the study, and (iv) the significance of the study that shows the global implications of the results the authors obtained.

Writing a good abstract takes practice as can be noticed by the differences in the abstracts I wrote in 2014 and 2019 (Fig. 2). Although Abstract A (see Sanganyado et al. [3].) was succinct at only 210 words, it had grammatical errors and some critical components were missing. However, Abstract B (see Zhuang et al. [5].) showed some improvement, the only problem was a single use of a superlative in describing the results. It is important to note that by the time I wrote the second abstract, I had prepared or contributed to the preparation of 15 abstracts.

Writing an honest abstract for your manuscript

A good scientific abstract should be objective and accurately present the results and their meaning or significance. The scientific endeavor is currently fixated on novelty and high impact, and this has resulted in an unhealthy obsession with the fantastic. A previous study found 107 out of 128 studies investigated contained at least one example of spin in the abstract [1]. The authors identified spin as ‘misleading reporting, misleading interpretation and inadequate extrapolation of the results’ through use of things like causal language, linguistic spin, insufficient statements on societal/practical implications, and absence of negative results (Table 1) [1].

Table 1 provides some recommendations for authors to ensure their abstracts are honest and true representative of the objectives, experimental procedure and results of the study. Briefly, authors should ensure that the principal results are accurate by avoiding misuse of statistical significance, overlooking negative results, overgeneralization, and unsubstantiated claims of causation. Authors should avoid using words and expressions such novel, for the first time, significantly higher/lower, and superlatives. A scientific study should arouse interest based on the merits of the research quality and not empty promises and falsehoods.

Writing a human and machine readable abstract

Search engine optimization

An effective abstract should be discoverable through search engines. After all, people use search engines (Google, Google Scholar, Bing) and scientific databases (SCOPUS, Web of Science) to search for research papers. These search engines use algorithms to rank the results for the search input. A result that is relevant is often ranked higher. My review on chiral pharmaceuticals (see Sanganyado et al. [2].) is ranked first on Google and second on Bing probably due to my organic use of the phrase chiral pharmaceuticals (Fig. 3). I used the phrase five times and its variant twice and offered its brief definition. Relevancy is often determined by the presence and organic use of keywords. Therefore, researchers should identify the keywords of their research (normally the keyword is the research topic) and use them in the abstract naturally.

a)

(Background of study is missing) We report for the first time the effect of liophilic mobile phase additives on the mechanism of chiral recognition of basic chiral pharmaceutical on a vancomycin based chiral stationary phase (CSP). Using methanol as the mobile phase and 0.005% formic acid as pH modifier, we evaluated the effect of different concentrations of three types of liophilic anions, formate (HCOO⁻), nitrate (NO₃⁻), and acetate (CH₃COO⁻), on enantioresolution (Rs), enantioselectivity (α) and retention factor (k) of enantiomers of fluoxetine and atenolol. The effect of liophilic ion types on k followed the Hofmeister series: CH₃COO⁻ > HCOO⁻ > NO₃⁻. Increasing concentration from 4 to 20 mM resulted in decreases in Rs and k in accordance to hydrophobicity of the liophilic anion. The effect of temperature or mobile phase composition on enantioseparation was determined at 13–40 °C. For both analytes, standard changes in enthalpy (ΔH°) and entropy (ΔS°) calculated using van't Hoff plots ($\ln k$ against $1/T$) varied from -4.99 to -0.63 kJ/mol and -11.82 to 9.47 J/mol, respectively. The van't Hoff plots showed elution order of the enantiomers of each analyte did not reverse in the temperature range studied. Chiral recognition of the enantiomers of atenolol and fluoxetine in the presence of liophilic ions was enthalpy driven. The significance of the study on the development of the research area is missing.

- ES Why is it important to know this?
- ES Information on the instrument in which the study was conducted is missing.
- ES These key terms are not defined and might confuse the reader. Anyone not actively studying chiral chromatography might not know what they mean.
- ES To what extent was the decrease? Be exact.
- ES There are too many abbreviated terms in the abstract. A reader has to look up to find what these terms mean.
- ES This is good. It is better to use the exact the results rather than superlatives like "the enthalpy decreased sharply while entropy rapidly increased."

b)

Nearshore environments are a critical transitional zone that connects the marine and terrestrial/freshwater ecosystems. The release of anthropogenic chemicals into nearshore ecosystems pose a human and environmental health risk. We investigated the microbial diversity, abundance and function in metal-contaminated sediments collected from the Rongjiang, Hanjiang and Lianjiang River estuaries and adjacent coastal areas using high throughput sequencing. The concentration of nutrients (NO₃-N, NO₂-N, NH₄-N, PO₄-P) and metal (Cu, Zn, Cd, Pb, As, Hg) contaminants were higher at the mouth of the rivers compared to the coastal lines, and this was confirmed using cluster analysis. Estimates obtained using geoaccumulation index showed that about 38.9% of the sites were contaminated with Pb and the pollution load index showed that sediment from the mouth of Hanjiang River Estuary was moderately polluted with metals. In the nearshore sediment samples collected, Proteobacteria, Bacteroidetes, Planctomycetes, Chloroflexi, Acidobacteria were the dominant phylum with relative abundances of 46.6%, 8.05%, 6.47%, 5.26%, and 4.59%, respectively. There was no significant correlation between environmental variables and microbial abundance and diversity except for total organic carbon (TOC) (diversity; $r=0.569$, $p<0.05$) and Cr (diversity; $r=0.581$, $p<0.05$). At phyla level, Nitrospirae had a significant negative correlation with all metals except Cr, while OD1 had a significant positive correlation with all the metals. Overall, changes in nearshore sediment microbial communities by environmental factors were observed, and these may affect biogeochemical cycling.

- ES Edmono Sanganyado
The problem the study seeks to address is clearly stated.
- ES Edmono Sanganyado
The research method identified the sample site, nature of samples, and the key instrumental technique used for analysis.
- ES Edmono Sanganyado
How high? It is important to avoid superlatives.
- ES Edmono Sanganyado
Exact values like this are more informative than superlatives.
- ES Edmono Sanganyado
Report negative results and avoid spin.
- ES Edmono Sanganyado
A good abstract includes a significance of study that is accessible to readers of varying expertise.

Fig. 2. Critique of abstract in (a) Sanganyado et al. [3], and (b) Zhuang et al. [5].

Table 1

Common types of spin in abstracts and how to reduce them (adapted from Lazarus et al. [1]).

Type of spin	Strategy used	Definition	Recommendation
Misleading reporting	No negative results reported	Results are presented in abstract without mention of the negative results reported in the Results and Discussion of the research paper.	The authors should include a line or two on the negative results, if they found any.
	Overemphasis on secondary results	When primary results addressing the primary objective are negative or lack statistical significance, authors highlight the secondary results.	Authors should give prominence to the primary results even if they are negative. Secondary results should get only a single brief sentence.
	Misleading description of experimental approach	Experimental approach is presented as robust, novel, and of global significance than it is.	Authors should briefly present what they did in one or two sentences. If the paper is about a technique, more sentences can be used.
	Use of linguistic spin	Use of superlatives to emphasize or exaggerate the 'fantastical' trends or novelty of the results.	Authors should avoid using superlatives (such as very high/low) in the abstract and use exact results instead.
	Overlooking research limitations	Research limitations are not considered when interpreting the results.	The authors should be aware of the limitations of their instruments, research procedure, sample size, etc. when explaining the meaning of their results.
Inadequate interpretation	Claim an effect when there is no statistical significance observed	The effect of some factors is overstated even though no statistical significance was observed in the study.	Authors should avoid writing that a statistically significant result was found but report the p-value or effect size instead.
	Claim a cause and effect link between a result and an event.	Principal results are stated as if the authors found a direct link between an event, procedure, factor with the outcomes.	Authors should only make a causal claim when they conducted a mechanistic study to validate the cause and effect link.
	Claim there was significant difference without conducting corresponding statistical test	A set of treatments are compared by mere observation of trends on a graph or difference in values of the results obtained.	Authors should only claim differences between treatments following an appropriate statistical test. Furthermore, authors should avoid using superlatives such as treatment A was higher than treatment B when no statistical tests were conducted.
	Overlooking the relevance of a result and focusing on statistical significance	Authors emphasize statistical significance rather than the effect size for a bigger picture. For example, a wastewater was treated to increase pH from 5.0 to 7.0 using an adsorbent or biological treatment. If a difference of 0.2 was observed with a p value of 0.003, it is disingenuous to report the p-value.	Authors should focus more on the relevance of the effect size and not the statistical significance.
Inadequate extrapolation	Overgeneralization	Results are generalized to different populations, scenarios, applications or outcomes beyond those directly investigated in the study.	Authors should extend their findings to circumstances of which they are meant to be applied only.
	Inadequate implication for practical application	Authors claim the developed techniques, product or procedure can be used for practical purposes with no experimental validation.	Authors should ensure if they claim any practical application, their experiments would have validated it.

Human reader optimization

A good abstract should be readable. They are several writing bad habits that often render abstracts unreadable, examples include;

- (1) Long sentences – authors should write short sentences and cut any clutter.
- (2) Too many abbreviations – abbreviations should be fully described and limited to at most three. Too many abbreviations confuse the reader. If possible, the authors should avoid use of abbreviations in the abstract.
- (3) Undefined technical terms – *Scientific African* is a multidisciplinary journal. Therefore, authors should minimize jargon in the abstract and use it when clearly and succinctly defined.
- (4) Poor connectivity/structure/organization – the background, objective, experimental approach, and significance of study should be aligned.

More than 50% of pharmaceuticals in current use are chiral compounds. Enantiomers of the same pharmaceutical have identical physicochemical properties, but may exhibit differences in pharmacokinetics, pharmacodynamics and toxicity. The advancement in separation and detection methods has made it possible to analyze trace amounts of chiral compounds in environmental media. As a result, interest on chiral analysis and evaluation of stereoselectivity in environmental occurrence, phase distribution and degradation of chiral pharmaceuticals has grown substantially in recent years. Here we review recent studies on the analysis, occurrence, and fate of chiral pharmaceuticals in engineered and natural environments. Monitoring studies have shown ubiquitous presence of chiral pharmaceuticals in wastewater, surface waters, sediments, and sludge, particularly β -receptor antagonists, analgesics, antifungals, and antidepressants. Selective sorption and microbial degradation have been demonstrated to result in enrichment of one enantiomer over the other. The changes in enantiomer composition may also be caused by biologically catalyzed chiral inversion. However, accurate evaluation of chiral pharmaceuticals as trace environmental pollutants is often hampered by the lack of identification of the stereoconfiguration of enantiomers. Furthermore, a systematic approach including occurrence, fate and transport in various environmental matrices is needed to minimize uncertainties in risk assessment of chiral pharmaceuticals as emerging environmental contaminants.

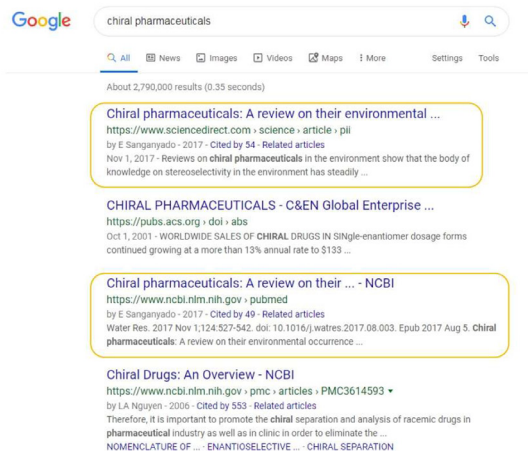


Fig. 3. Organic use of the chiral pharmaceuticals in Sanganyado et al. [2], and the resulting ranking on Google Search.

Conclusion

Since an abstract is a window to a study, authors should ensure that the abstract is accurate, honest, readable, and discoverable. This paper has shown that a good abstract should quicken the interest of the reader without spinning for attention.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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