Writing a scientific paper

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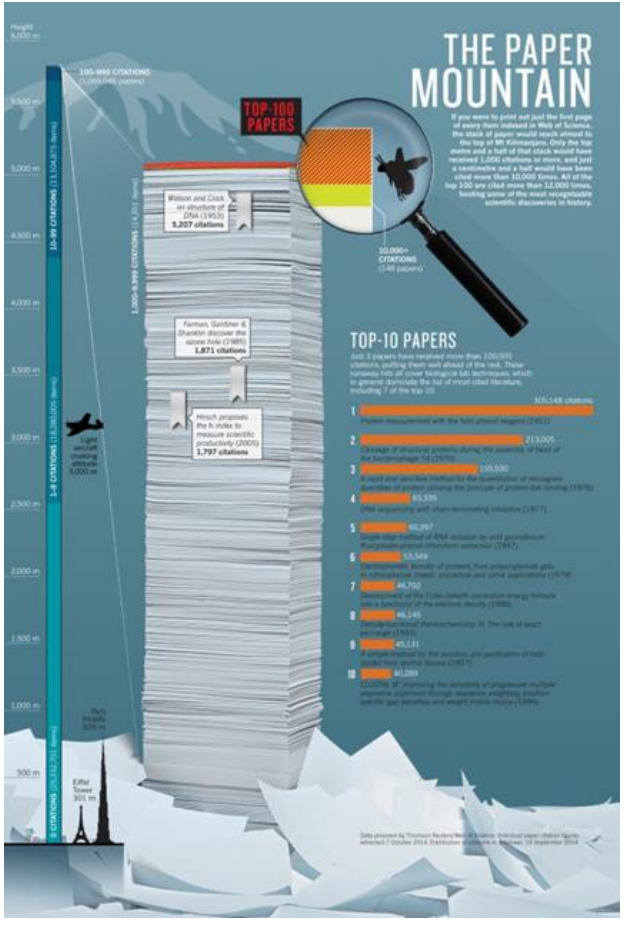
SPRINGER NATURE

Outline

1	Introduction
2	Before writing – Main message and readership
3	Title and Abstract – Excercises
4	The structure of your paper
5	Figures and captions
6	Editorial process – If you have any curiosities

Mountains of Papers



350 years of scientific publishing

1665

Philosophical Transactions of the Royal Society

and

Journal des sçavans (1665-1792)

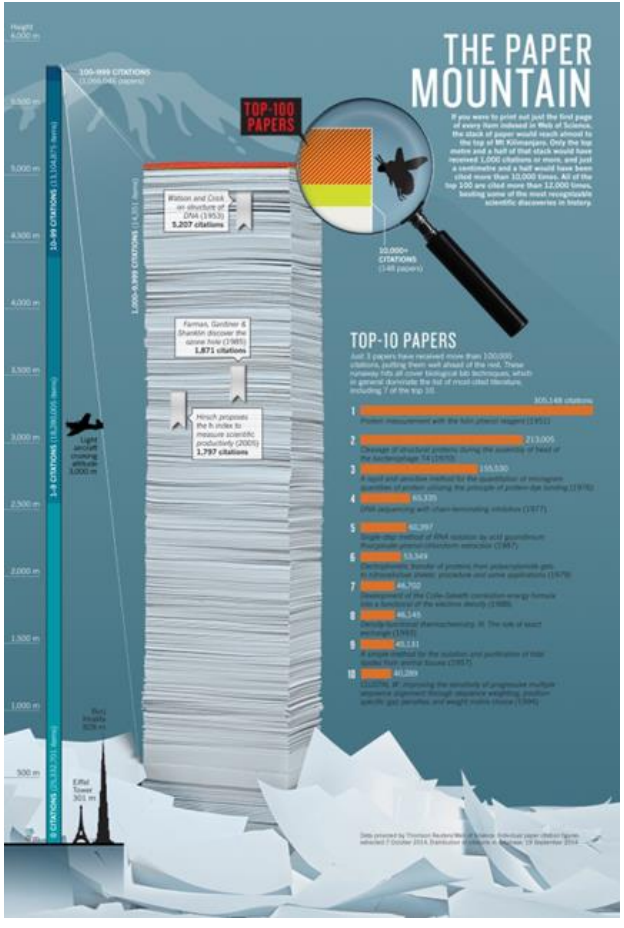
2021

> 21000 peer-reviewed journals

~ 85 million papers in Web of Science

nature portfolio

Mountains of Papers



Good news:
Writing papers is a well-established practice

Bad news:
Out there, millions of people are writing one

Take Home Message:

The discoverability of your results is important!

Mountains of Papers

What's the purpose of writing scientific papers?

~~To get a job~~

To communicate and disseminate research (and get a job)

The value of journals in the era of preprints

Filter **Enhance** **Amplify**

The Nature Portfolio of journals

Subscription:
Publish for free
Pay to read
Embargo
Journal gets copyright

Selectivity, Impact

npj nature partner journals

COMMUNICATIONS BIOLOGY

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COMMUNICATIONS PHYSICS

SCIENTIFIC REPORTS

Pay to publish
Read for free
Retain the copyright

Breadth of scope

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Communications Physics

- Selective **open access** journal
- **Significant advances**, new insights to **specialized** areas of Physics
- **Broad Scope:** publishing across all areas of Physics
- **Combined Editorial Model:** Academic and Professional Editors involved in the assessment and peer review.
- **Launched 2017 –** receives transfer of articles from other Nature Research journals

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Federico Battiston
Central European University
Austria

Michael T. Schaub
RWTH Aachen University
Germany

Marta Sales-Pardo
Universitat Rovira i Virgili
Spain

nature portfolio

Writing

Writing a scientific paper

… for quality journals

Writing

Writing a scientific paper

… for quality journals

Dr. Leonardo Benini

Senior Editor

nature physics

A special “Thanks”

Before writing

1. Identify your main message and your target readership

Identify the main message

Ask yourselves these questions

- What is the **main advance**?
- What do we learn that is **new**?
- Why is it **significant**?
- What **impact** is it going to have?

Identify your readership

Tip 1

Can you promote your whole paper in 5 minutes to some fellow scientist in a **very different discipline** (chemistry, biology, engineering)?

Yes

Focus on the narrative around the main message, keep the science **complete** but **simple**.

No

Identify your readership

Tip 1 Can you promote your whole paper in 5 minutes to some fellow scientist in a **very different discipline** (chemistry, biology, engineering)?

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No

Tip 2 Can you promote your whole paper in 5 minutes to some fellow scientist working in the **same discipline** but **a very different area**? (e.g. condensed matter, optics?)

Yes

Be aware of what is a **standard physics training is**. Think about your bachelor and master's programs and adapt the language to reach physicists.

No

Identify your readership

Tip 1 Can you promote your whole paper in 5 minutes to some fellow scientist in a **very different discipline** (chemistry, biology, engineering)?

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Yes

Be aware of what is a **standard physics training is**. Think about your bachelor and master's programs and adapt the language to reach physicists.

No

Tip 3 Can you promote your whole paper in 5 minutes to some physicist fellow working in your **same field**?

Yes

Be aware of what is the **common knowledge** in **your field.**

No

Work on your main message

The Nature Portfolio of journals

Subscription:
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Embargo
Journal gets copyright

Selectivity, Impact

npj nature partner journals

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Writing for quality journals

2. The ideal requisites of your paper

Writing

The ABC of writing style

a accurate

b brief

c clear

Writing

And the DEF

d declarative

e engaging

f focussed (on the main new finding)

Writing for quality journals

3. The title

Titles

First thing that people see
How people finds your work

- Make the **main topic** clear
- Be **descriptive** but not TOO detailed
- Avoid **jargon** and **acronyms** and **puns**
- Include **keywords** to enhance discoverability
- Be wary of using **punctuation** in titles (avoid questions)
- Make the title **understandable** on first reading

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Tip

Check your tentative title on Google Scholar/Scopus: Do you get relevant related papers?

Titles | How NOT to

"~~Quantum Bowling:~~ Particle-hole transmutation in one-dimensional strongly interacting lattice models"

"~~Topological Schrödinger cats:~~ Non-local quantum superpositions of topological defects"

"Multi-Physics Surrogate Model for Light-Controllable Nano-Patterned Surfaces with On-Demand Optical-Bactericidal-Frictional Properties"

"Optimizing PAPR, BER, and PSD Efficiency: Using Phase Factors Generated by Bacteria Foraging Algorithm for PTS and SLM Methods"

"Schrödinger's cat versus photon"

"A flea on Schrödinger's cat"

"Internal environment: What is it like to be a Schrödinger cat?"

Titles | Declarative

“Hetero-site-specific ultrafast intramolecular dynamics”

- Make the **main message** clear
- Be **descriptive** but not TOO detailed
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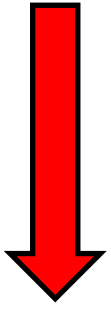
Titles | Declarative

“Hetero-site-specific ultrafast intramolecular dynamics”



- Make the **main message** clear
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Article | OPEN

Hetero-site-specific X-ray pump-probe spectroscopy for femtosecond intramolecular dynamics

Titles | Declarative

“Quantum signatures of synchronization”

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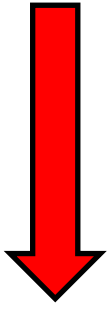
Titles | Declarative

“Quantum signatures of synchronization”



- Make the **main message** clear
- Be **descriptive** but not TOO detailed
- Include **keywords** to enhance discoverability

Classical synchronization indicates persistent entanglement in isolated quantum systems

Titles | Take-home message

- Make the **main message** clear
- Be **descriptive** but not TOO detailed
- Include **keywords** to enhance discoverability

Tip

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Writing for quality journals

4. The abstract

Abstract | The importance of a good abstract

~ 85 million papers in Web of Science

Fact 1	Your abstract should contain optimized **keywords** for research engines. Test them!
Fact 2	The abstract is the **only thing reviewers read** before accepting to review. It boosts your chances of securing appropriate reviewers and avoid delays
Fact 3	It helps **securing a talk** at conferences
Fact 4	It ensures **your work is displayed** in the “related papers”when people runs a “similar articles” check
Fact 5	**Convinces the reader** to go on reading

nature portfolio

Abstract | How to waste space and annoy your reader

Don’t alienate your reader!

“Topological insulators are a novel quantum state of matter that reveals their properties and shows exotic phenomena when combined with other phases.”

This innovative approach referred to as SLM-BFA and PTS-BFA, has the potential to enhance the performance of the OTFS waveform by mitigating the PAPR problem.

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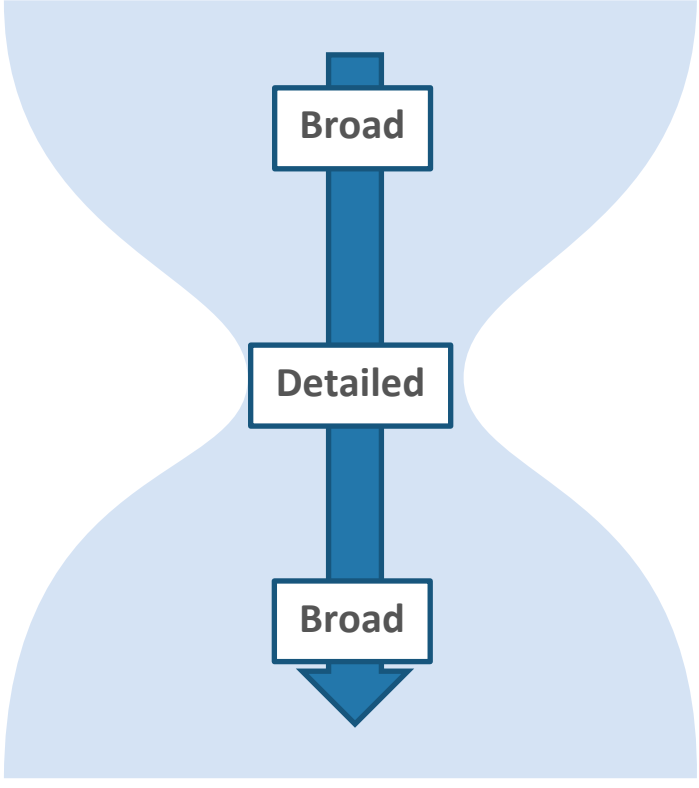
Tip 1	Indicate three or four key phrases and relevant keywords to construct your abstract and repeat these in a natural and appropriate way.
Tip 2	Acronyms and hyperbolic language don’t give any benefits. They waste space for optimizing the **keywords** and your narrative.

Abstract | Your mini-paper



Abstract | Your mini paper

Typical structure of a paper

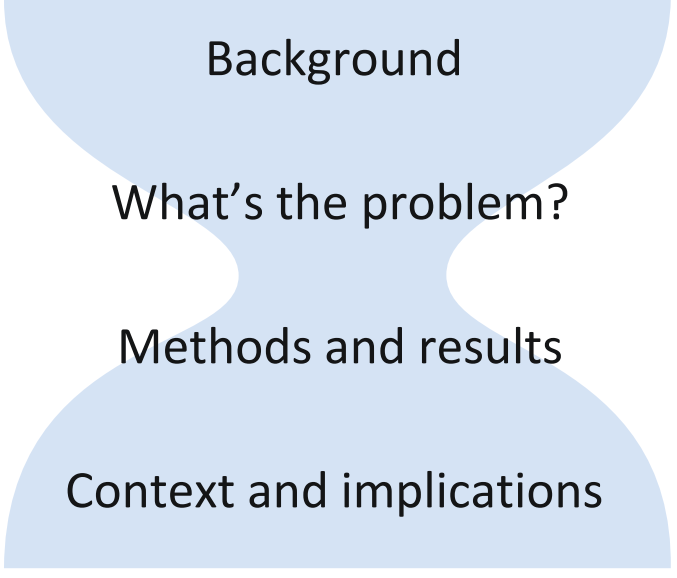
Background

What's the problem?

Methods and results

Summary and conclusions

Typical structure of an abstract



Abstract

Think about your 5 minutes promotion: it is your mini-paper.
It should reflect the language and breadth of readership of the target journal.

Abstract | Your mini paper

Set the stage

Main result

Analysis & Implications

Sources such as [y] are interesting because [provide a brief explanation for the context]. Crucial to our understanding of such objects is a measurement of [z], because this has the potential to tell us [b]. In the past, this has been difficult/impossible to accomplish, because […]. Here, we have measured/calculated [z] using [x] and find that it is [expected/unexpected]. In light of this result, our understanding of the physical process underlying [b] is [changed, advanced…]. We have accordingly determined that… [now relate back to the earlier problems so that advance is clear].

Abstract | Your mini paper

Do

- Make the **question being addressed** clear
- Summarize your most **important findings**
- Note the **implications** of your work

Don’t

- Provide **detailed methodological information** (unless it’s a methods paper)
- Use **uncommon abbreviations** and acronyms
- Specifically **reference figures**
- Use **hyperbolic language**

Abstract | Context

DON'T TELL the reader that the thing you're working on is important:

"Entanglement is ubiquitous in quantum systems, and has been intensively studied by many researchers for decades."

SHOW the reader **WHY** the thing you're working on is important:

"The presence of entanglement in quantum systems can be directly related to their potential to be used in tasks that are beyond the reach of classical approaches."

Abstract | Knowledge Gap

DON'T JUMP to the results

"Entanglement is ubiquitous in quantum systems, and has been intensively studied by many researchers for decades. Here we present an experimentally-friendly method to measure multi-partite entanglement."

GUIDE the reader through the abstract:

"The presence of entanglement in quantum systems can be directly related to their potential to be used in tasks that are beyond the reach of classical approaches. However, reliably detecting the presence of entanglement between more than two systems remains an experimentally challenging task."

Abstract | Your results

DON'T try to convince the reader your results are significant.

"Here we shed important light and report a paradigm shift in our understanding of multi-partite entanglement."

Abstract | Your results

DO tell the reader the extraordinary thing you've discovered!

"Here we derive multi-partite entanglement witnesses that can be realized with only two collective measurements on any quantum system."

Abstract | Take-home message

- Reflect the structure of the paper
- Provide context by guiding the reader to the open question and relevance
- Avoid general statements and hyperbolic wording
- Be complete but not too detailed
- Keywords, keywords, keywords. Make your article discoverable.

Abstract | Take-home message

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- Provide context by guiding the reader to the open question and relevance
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Tip 1	Three or four **key phrases** and **relevant keywords**, repeat these in a natural and appropriate way.
Tip 2	Acronyms and hyperbolic language don't give any benefits. They waste space for optimizing the **keywords** and your narrative.
Tip 3	Check the keywords in your abstract on Google Scholar/Scopus: Do you get relevant related papers?

Exercises

Comment on the following abstracts:

1) What is the current target readership?

2) Could they be adjusted for another readership?

3) Where could they be expanded?

4) Where could they be simplified?

5) What parts are completely unnecessary?

Exercise 1

Open systems with gain and loss, described by non-trace-preserving, non-Hermitian Hamiltonians, have been a subject of intense research recently. The effect of exceptional-point degeneracies on the dynamics of classical systems has been observed through remarkable phenomena such as the parity-time symmetry breaking transition, asymmetric mode switching, and optimal energy transfer. On the other hand, consequences of an exceptional point for quantum evolution and decoherence are hitherto unexplored. Here, we use post-selection on a three-level superconducting transmon circuit with tunable Rabi drive, dissipation, and detuning to carry out quantum state tomography of a single dissipative qubit in the vicinity of its exceptional point. Quantum state tomography reveals the PT symmetry breaking transition at zero detuning, decoherence enhancement at finite detuning, and a quantum signature of the exceptional point in the qubit relaxation state. Our observations demonstrate rich phenomena associated with non-Hermitian physics such as non-orthogonality of eigenstates in a fully quantum regime and open routes to explore and harness exceptional point degeneracies for enhanced sensing and quantum information processing.

Readership: specialised

Open systems with gain and loss, described by **non-trace-preserving, non-Hermitian Hamiltonians**, have been a subject of intense research recently. The effect of exceptional-point degeneracies on the dynamics of classical systems has been observed through remarkable phenomena such as the **parity-time symmetry breaking transition, asymmetric mode switching, and optimal energy transfer.** On the other hand, consequences of an exceptional point for quantum evolution and decoherence are hitherto unexplored. Here, we use **post-selection on a three-level superconducting transmon circuit with tunable Rabi drive, dissipation, and detuning to carry out quantum state tomography of a single dissipative qubit in the vicinity of its exceptional point.** Quantum state tomography reveals the PT symmetry breaking transition at **zero detuning, decoherence enhancement at finite detuning, and a quantum signature of the exceptional point in the qubit relaxation state**. Our observations demonstrate rich phenomena associated with non-Hermitian physics such as non-orthogonality of eigenstates in a fully quantum regime and open routes to explore and harness exceptional point degeneracies for enhanced sensing and quantum information processing.

Context: poor

Open systems with gain and loss, described by non-trace-preserving, non-Hermitian Hamiltonians, have been a **subject of intense research recently**. The effect of exceptional-point degeneracies on the dynamics of classical systems has been observed through remarkable phenomena such as the parity-time symmetry breaking transition, asymmetric mode switching, and optimal energy transfer. On the other hand, **consequences of an exceptional point for quantum evolution and decoherence are hitherto unexplored**. Here, we use post-selection on a three-level superconducting transmon circuit with tunable Rabi drive, dissipation, and detuning to carry out quantum state tomography of a single dissipative qubit in the vicinity of its exceptional point. Quantum state tomography reveals the PT symmetry breaking transition at zero detuning, decoherence enhancement at finite detuning, and a quantum signature of the exceptional point in the qubit relaxation state. Our observations demonstrate **rich phenomena** associated with non-Hermitian physics such as **non-orthogonality of eigenstates in a fully quantum regime and open routes to explore and harness exceptional point degeneracies for enhanced sensing and quantum information processing.**

Language: unnecessarily hyped

Open systems with gain and loss, described by non-trace-preserving, non-Hermitian Hamiltonians, have been a subject of intense research recently. The effect of exceptional-point degeneracies on the dynamics of classical systems has been observed through **remarkable phenomena** such as the parity-time symmetry breaking transition, asymmetric mode switching, and optimal energy transfer. On the other hand, consequences of an exceptional point for quantum evolution and decoherence are hitherto unexplored. Here, we use post-selection on a three-level superconducting transmon circuit with tunable Rabi drive, dissipation, and detuning to carry out quantum state tomography of a single dissipative qubit in the vicinity of its exceptional point. Quantum state tomography reveals the PT symmetry breaking transition at zero detuning, decoherence enhancement at finite detuning, and a quantum signature of the exceptional point in the qubit relaxation state. Our observations demonstrate **rich phenomena** associated with non-Hermitian physics such as non-orthogonality of eigenstates in a fully quantum regime and open routes to **explore and harness exceptional point degeneracies for enhanced sensing and quantum information processing.**

Reformulating it for a general readership

Open physical systems can be described by effective non-Hermitian Hamiltonians, that characterize the gain or loss of energy from the system. Experimental realization of optical and mechanical non-Hermitian systems has demonstrated functionalities such as lasing, topological features, optimal energy transfer and enhanced sensing. Such realizations have been limited to classical (wave) systems in which only the amplitude information is measured. Thus, the effects of a system's proximity to an exceptional point—a degeneracy of such non-Hermitian Hamiltonians—on its quantum evolution remain unexplored. Here, we use quantum state tomography to study the behaviour of a single dissipative qubit in the vicinity of its exceptional point. We observe the spacetime reflection symmetry-breaking transition at zero detuning, decoherence enhancement at finite detuning and a quantum signature of the exceptional point in the qubit relaxation state. Our experiments extend the phenomena associated with non-Hermitian physics (such as non-orthogonality of eigenstates) to a fully quantum regime, which could provide a route to the exploration and harnessing of exceptional point degeneracies for quantum information processing.

Exercise 2

In the era of big data, it is a very challenging task to detect the critical points of phase transitions and their driver factors of complex systems from data, such as the early warning signals of cancers. The dynamic network biomarker/marker (DNB) method derived from the bifurcation theory is currently very popular, but there are some difficulties in actual applications. Therefore, inspired by the percolation theory, we propose for the first time a giant-component-based DNB (GDNB) method that directly selects the largest DNB as the transition core to reflect the progress of the transition. The remarkable efficiency of this was verified on three systems: Monte Carlo simulations of 2D Ising model, MD simulations of protein folding, and measured gene expression time course in mouse muscle regeneration. Unlike DNB, our novel criterion picks the most likely DNB. These results suggest that the GDNB method not only inherits the advantages of the DNB method, but also improves the interpretability while reducing the computational complexity, paving the way to controlling phase transitions.

Readership: specialised

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Language: Overhyped

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Exercise 2

Detecting critical points of phase transitions and their driver factors offers a promising direction to predict and control such transitions in complex systems. An efficient tool towards this aim is the dynamic network biomarker/marker (DNB) method, that allows identifying the states of the system close to the tipping points from experimental data, granting insight on the key factors driving the transition. However, such method relies on the comparison of two sets of data to ensure no duplicate results are obtained, making it inapplicable to the common situation where a single set of data is available. Here, we propose a giant-component-based DNB (GDNB) method inspired by the percolation theory, that directly selects the largest DNB to reflect the progress of the transition. We test our scheme by detecting the transitions in three distinct systems: Monte Carlo simulations of the 2D Ising model, molecular dynamics simulations of protein folding, and measured gene expression time course in mouse muscle regeneration. Our tests show that the GDNB method inherits all the advantages of the DNB method, with reduced the computational complexity and working for single data sets. These improvements on DNB could provide a powerful tool to predict phase transitions in complex systems, together with identifying the key players to control them.

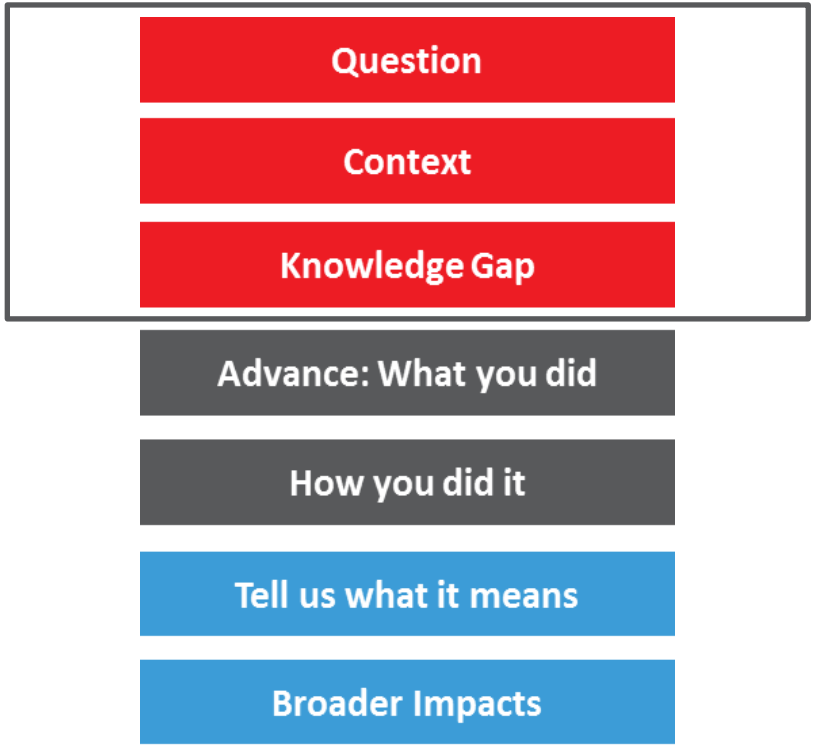
Writing for quality journals

6. The main body

The outline of a compelling narrative

Introduction

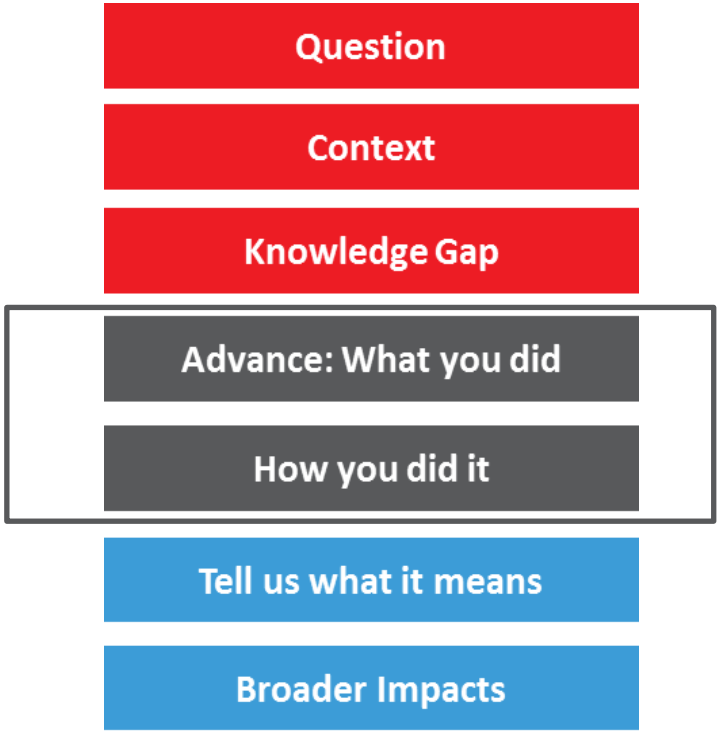
- **Tell us why we should care.**
- Clear rationale for the study.
- **Set the background**, and do not assume knowledge
- Good scholarship: what is the state of knowledge?
- How does your work address the major questions?
- What is the **the main** take-home message?



Tip 1	None should ask themselves “so what?” after reading your introduction
Tip 2	Never hide references potentially undermining the novelty. Explain them!

Results

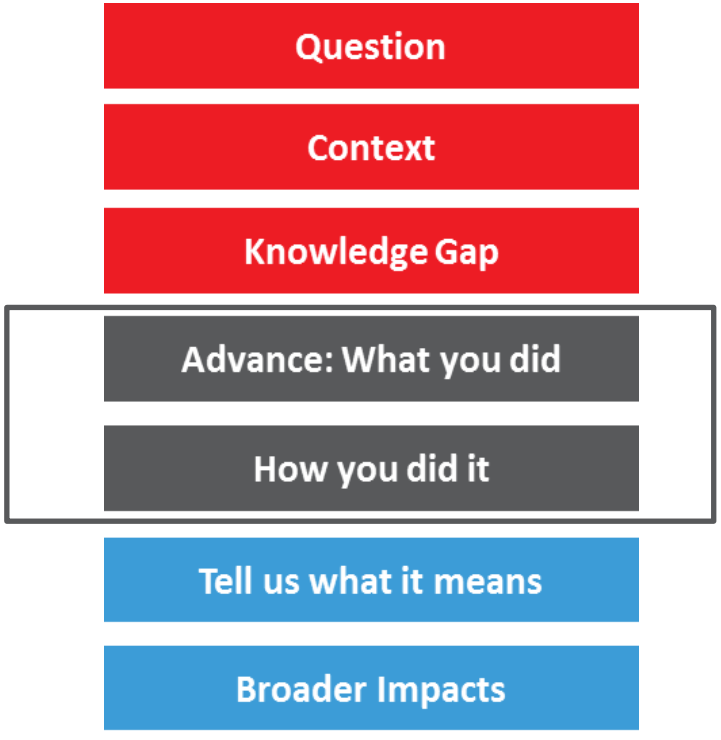
- Identify **key** claims.
- Present evidence in **logical** order, not **chronologically**.
- Describe **methods** for each result, but keep it essential.



Tip 3	Explain, **don't hype**. Show, don't tell.
Tip 4	The part you **found more challenging** is probably uninteresting.

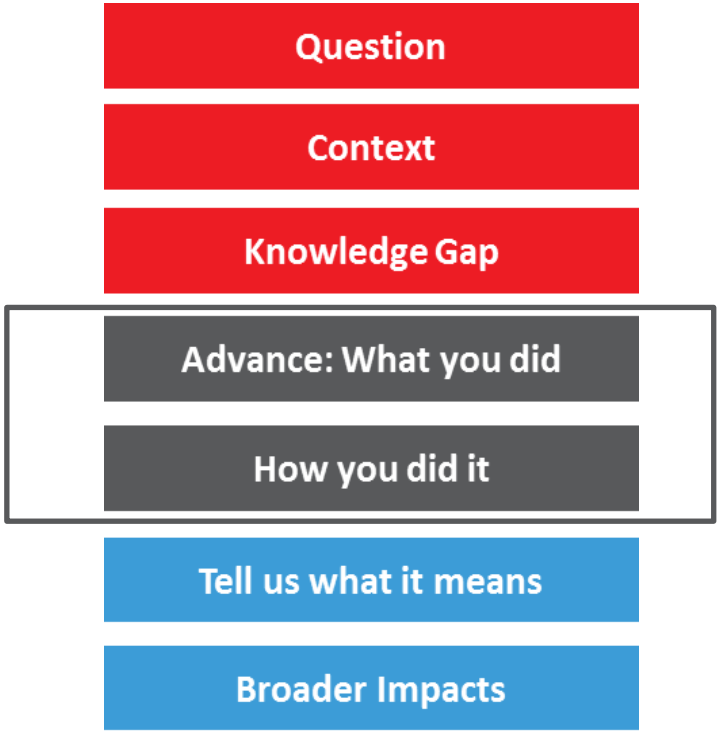
Results | Figures

- Present in **logical order**
- **Clear** and understandable
- Exploit **diagrams** for complex ideas
- **Honest representation** of data.
- **Clarity** more than beauty.



Results | Captions

- Concisely describe **what is shown**
- Only essential **methodological information**
- **Describe, don't interpret**
- Provide detail on **the statistics**



Tip 5	Use markers, line styles and customized palettes (don't rely on the default ones, they are bad and ugly).
Tip 6	Be consistent with your colorscheme throughout the manuscript

Discussion and Conclusions

- **Brief** summary of the results and conclusions.
- How do the findings **fit** with previous research?
- What are the next steps?
- How should others **use** this research?

Tip 7	What have we learnt?
Tip 8	What now?

Discussion and Conclusions

- Summarize the **key results**
- Put the findings in **context**
- Discuss your **interpretation** of the data (including discrepancies)
- Address any **conflicts** with the literature
- Identify **limitations**
- Point to **future directions** (do not hype)

Tip 9 Being fair in limitations and outlook helps to speed-up the peer review process.

References

What to cite:

- Quotations, opinions, or predictions published by others
- Direct experimental methods, results, or statistics published by others
- Graphics published elsewhere

Be fair, balanced and complete

Avoid excessive self-citation

Don’t use to curry favor with referees or journal

Methods: the how-to

Detail to allow replication

Don’t rely too much on citations,
describe what you did

Consider posting an **online data or code**

Tip 10	Make your manuscript self contained. None wants to make a puzzle to reconstruct the approach.

Your Paper: Take-home messages and tips

Introduction:

Tip 1	None should ask themselves “so what?” after reading your introduction
Tip 2	Never hide references potentially undermining the novelty. Explain them!

Results and Figures:

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Discussions and Conclusions

Tip 7	What have we learnt?
Tip 8	What now?
Tip 9	Being fair in limitations and outlook helps to speed-up the peer review process.

Methods

Tip 10	Make your manuscript self contained. None wants to make a puzzle to reconstruct the approach.

Useful links and contacts

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@commsphys

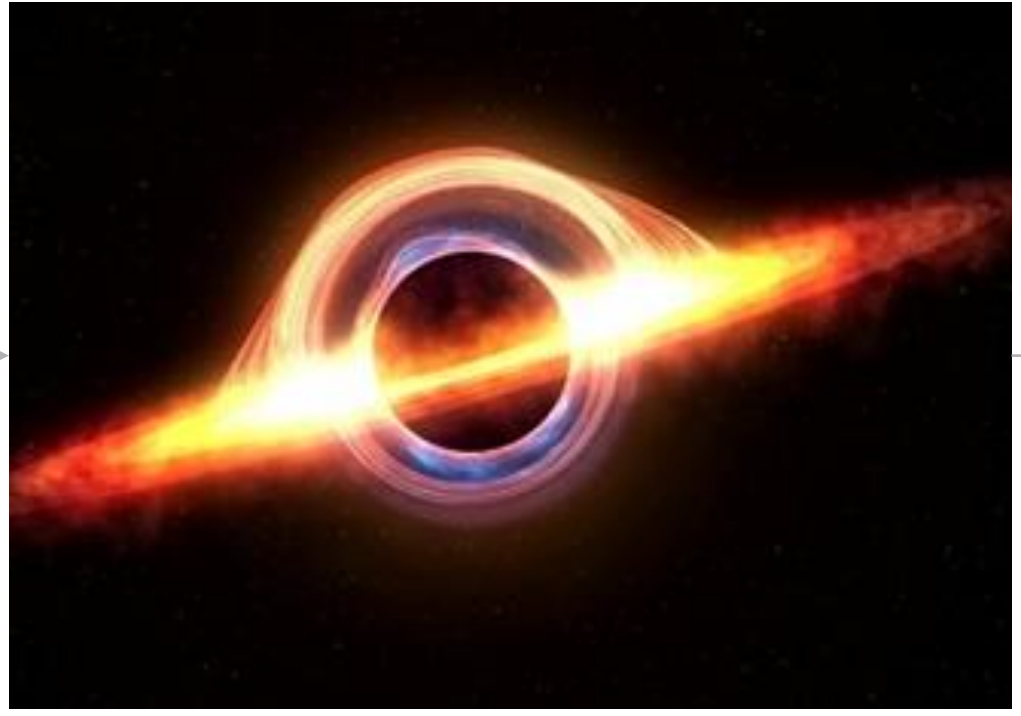
nature.com/commsphys

https://www.springernature.com/gp/open-research/policies/journal-policies/apc-waiver-countries

Case by case waivers/institutional coverage of APCs can be discussed with the OA office for authors in financial need OAfundingpolicy@springernature.com

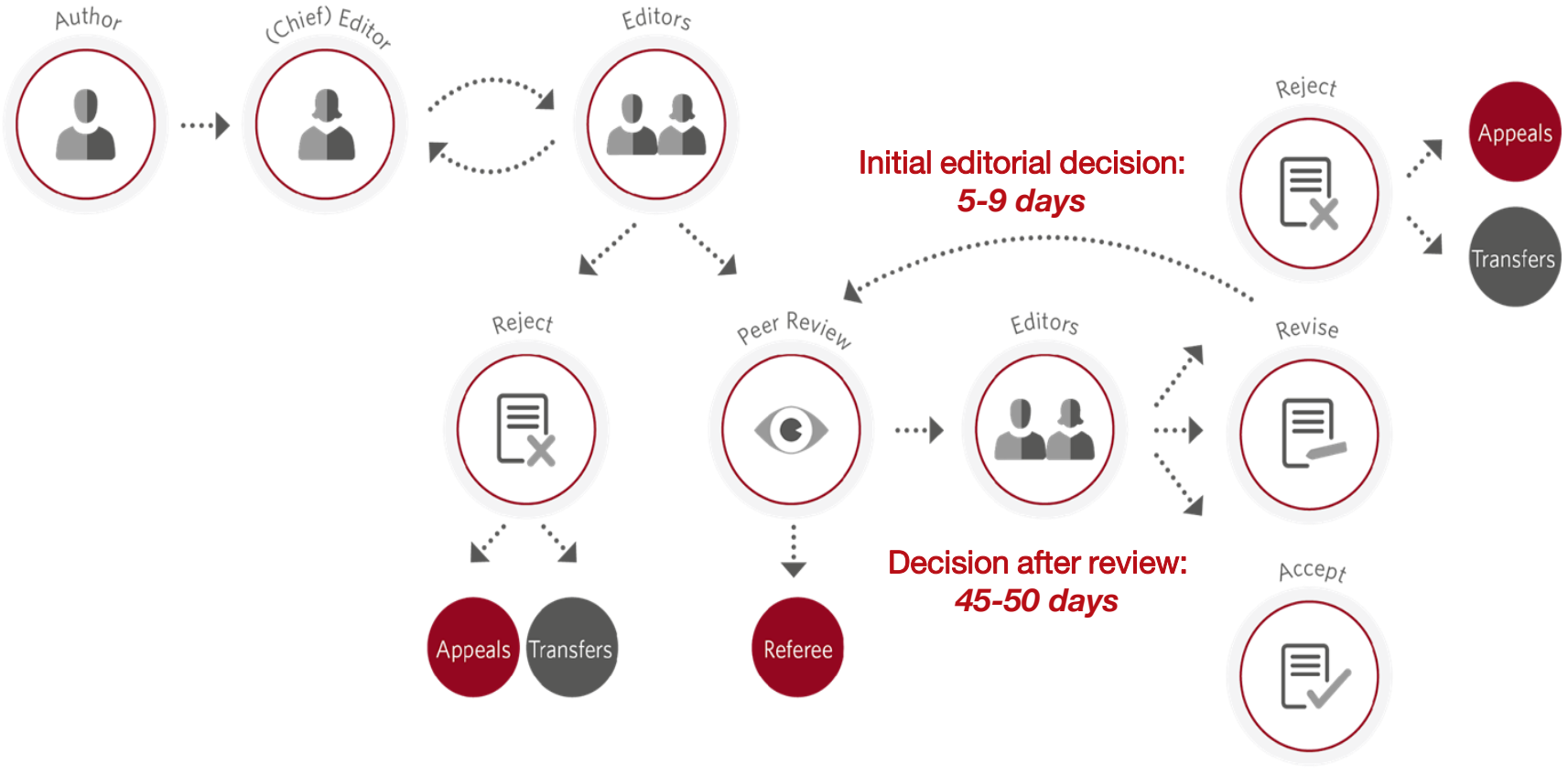
Understanding the editorial process

Authors

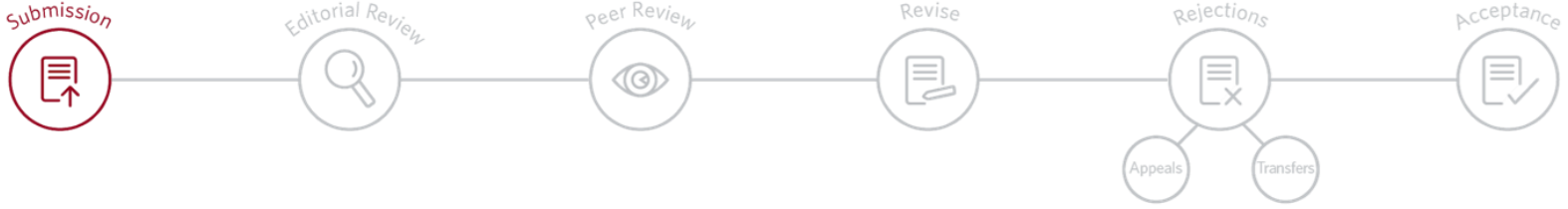


Reject

The Editorial Process



Finding the best fit



How 'big' is your story?

What audience do you want to reach?

How fast do you want to get it out?

Is **open access** important to you?

Does your work **build on** recent papers in the journal?

nature COMMUNICATIONS

COMMUNICATIONS PHYSICS

npj nature partner journals

SCIENTIFIC REPORTS

nature portfolio

Initial editorial evaluation at Nature Portfolio journals

Cover letters are important

- **Why your research is important**.
- **Specific advance** over previous work.

Timeliness is a priority: we aim for initial decisions within a week.

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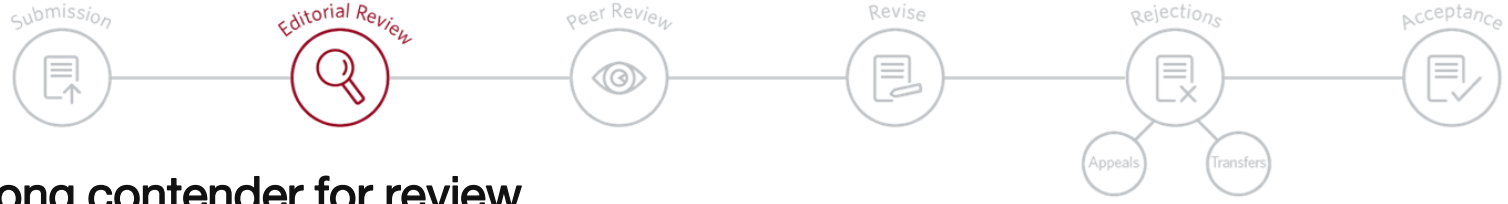
Myth	The editor does not read the manuscript nor the cover letter
Reality	The editor reads the **full manuscript** to determine whether it is potentially suitable for the journal.

What papers do we send out to peer review?



A strong contender for review...

1	Relevance to the journal's readership
2	Significance of the findings
3	Strong support for conclusions

Peer review - the cornerstone of all scientific publishing

Our editors:

- **Select reviewers with relevant expertise** to cover all areas of the papers.
- They send out only the **abstract** for reviewers to decide whether to review. The abstract is important!
- Honour author exclusions (within reason)

Myth	There is a very good database for finding reviewers
Reality	The reviewers are carefully selected by editors and editorial board members based on the expertise

Editorial Decisions

- **The decision is for the editors** — not the referees — to make.
- Editors make decision based on arguments: **we do not count votes.**
- **The goal of peer review is to improve paper**
- **We can be patient**: we can wait for additional experiments to be completed.

1	Criticism is an opportunity
2	Engage thoroughly - with new data if requested
3	When in doubt, ask the editor

Why might we reject a paper?

Before Peer Review

- **Topic is out of the journal's scope**
- **Similar findings have been published** or recently accepted
- Key conclusions **lack direct experimental support**
- There are serious **ethical concerns**

After Peer Review

- The conclusions and interpretations are **not sufficiently supported** by data
- There are significant **technical concerns**
- The findings are **not sufficiently novel or significant** enough for the field
- The paper lacks a **critical element**, such as a key experiment or impact

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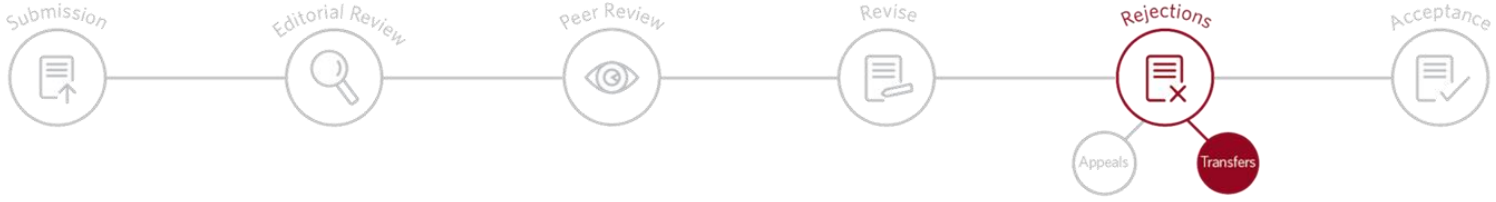
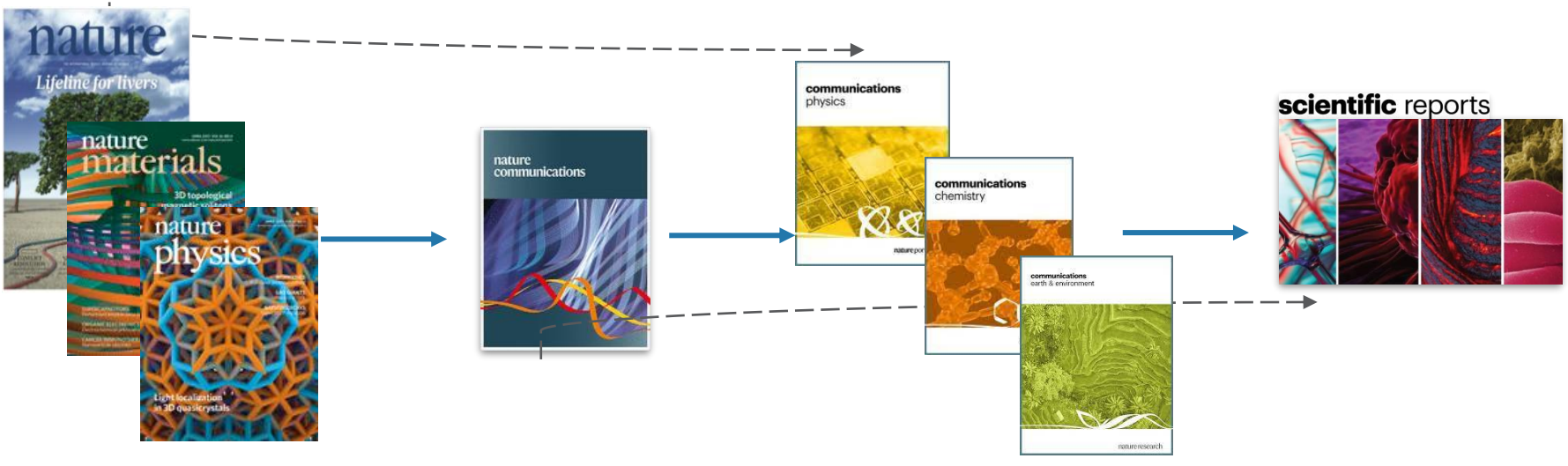
Myth	Bad English leads to desk rejection
Reality	Poor writing often masks poor science

Moving on: manuscript transfer at in the nature portfolio

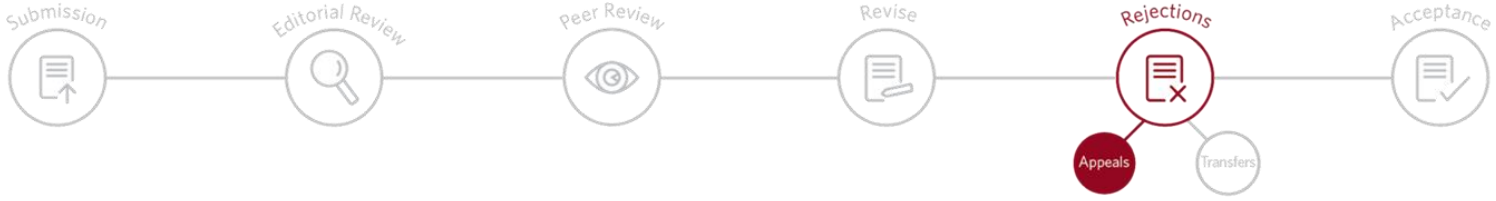


Editors want to find the **right home** for your article within the **portfolio**



nature portfolio

Appeals



If you think we've made a mistake and can explain why, let us know

What helps?

Specific errors of fact or understanding by the editors or referees

New data that addresses the major criticisms

What doesn't help?

"Do you know who I AM!?!"
"Referees don't like my work, therefore they are biased!"
"We worked really hard on this paper!"
"You're not qualified to make this decision!"
Celebrity endorsements
Cosmetic revisions
Irrelevant extensions

Key takeaways about the editorial process

- Make your main message (why research is important and new) clear in the cover letter and paper.
- Your handling editor will guide you through the editorial process.
- We look for papers with potential.
- The goal of peer review is to improve papers.
- Make the most of your opportunity to revise.
- Editors, not referees, take the ultimate responsibility for decisions.
- We consider appeals in cases where the concerns can be resolved.

Questions on the editorial process