SCIENCE JOURNALISM MANUAL

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PREFACE

Starting in 2017 the project ‘Scientific Storytelling’ began to explore the relationship between scientific research and journalism. The goal is to get a broader audience to engage with science, its principles, and achievements. While this is a worthwhile endeavour, it would also foster the insertion of scientific knowledge into common knowledge and help inoculate against fake news.

From 2017 to 2020 seventy-five journalists from Egypt, Tunisia, Jordan, Iraq, and Lebanon participated in workshops focused on science journalism. All the panels were open to the public, and numerous scientists and journalists were invited to present their views and findings. At the same time, exchange programmes for journalists from Egypt and Germany infused a sense for the challenges facing journalists when reporting on science in their respective countries. All of these efforts culminated in a conference in 2019 held under the title 'Science Meets Journalism – Multidisciplinary Perspectives'.

To make the work of this programme available to journalists in reporting on science and create a reference for the alumni of this project, we created this manual. It was written by Hanan Badr and Ashraf Amin and will highlight themes that have always been particular challenges to journalists covering science. Writing features and the utilisation of sources and references are abilities any journalist will need to have. There are also challenges that are more recent in nature and have either undermined the trust in journalism as an independent source of news or have a such a fundamental impact on our societies that accurate and informed reporting is more prescient than ever: the spread of pseudoscience and fake news is such a challenge that has been greatly amplified by the availability of social media. While at the same time the corona pandemic has made accurate reporting ever more important. This manual gives insight into these challenges and how journalists can try to address them.

As any journalist will readily admit, a picture can tell a thousand words. Hassan Moussa has provided the illustrations to this manual. No such project is the work of a single party only. This project enjoyed the support of numerous partners: The German Academic Exchange Service (DAAD) in Cairo, Al Ahram Newspaper, Al Manassa, Akademie für Publizistik in Hamburg, 10MOJO Egypt, and the German Foreign Office all contributed to this programme's success.

Susanne Höhn

Regional Director MENA
Goethe-Institut Kairo

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Science journalism manual

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We are living in a very important time in the history of the press industry locally, regionally and internationally, correlating with the challenges of survival, continuity and the ability to rejuvenate and modernize. Perhaps specialized journalism is not far from all of these changes, particularly scientific journalism.

In light of the local and international decline in paper publications and the decrease in advertising revenue, from both paper and online publishing, and the prevalence of communication platforms promoting random and free content, then finally the Corona epidemic that affected all aspects of life, including the media industry.

For all of the above, it has become necessary to have a new reading of the role and importance of scientific journalism in peoples' lives and the impact of its absence or replacement by writings that do not have the foundations of journalistic work, which are basically:

- Selection of topics that corresponds to people's interests aligning with their temporal and spatial circumstances.
- Fact checking.
- Drafting the content with a degree of impartiality and objectivity to elucidate the truth.
- Engage with the questions evoked in the readers' minds.

In the following manual, we were keen to list a number of general points that every prospective scientific editor should be aware of, whether by producing journalistic articles through his own blog and platform or by working in a media institution. The distinctive discourse comes from the quality of the content and the journalist's professionalism towards his writings, disregarding whichever platform he is publishing through.

The first chapter discusses writing scientific reports, the second one showcases the important sources for science journalism whereas the third chapter tackles pseudoscience and how to avoid it. The fourth chapter explains the effect of the spread of the Corona pandemic on science journalism at the moment, the fifth chapter looks at the arabization of scientific terms and the main challenges in this field Finally, chapter six proposes the effects of social media platforms on science journalism. At the end of each chapter we provided a list of contemporary resources.

In conclusion, we wish the readers to benefit from the evidence of scientific journalism in their practical life, and we thank the Goethe Institute for its persistence in creating and developing contents that boost science journalism.

The authors

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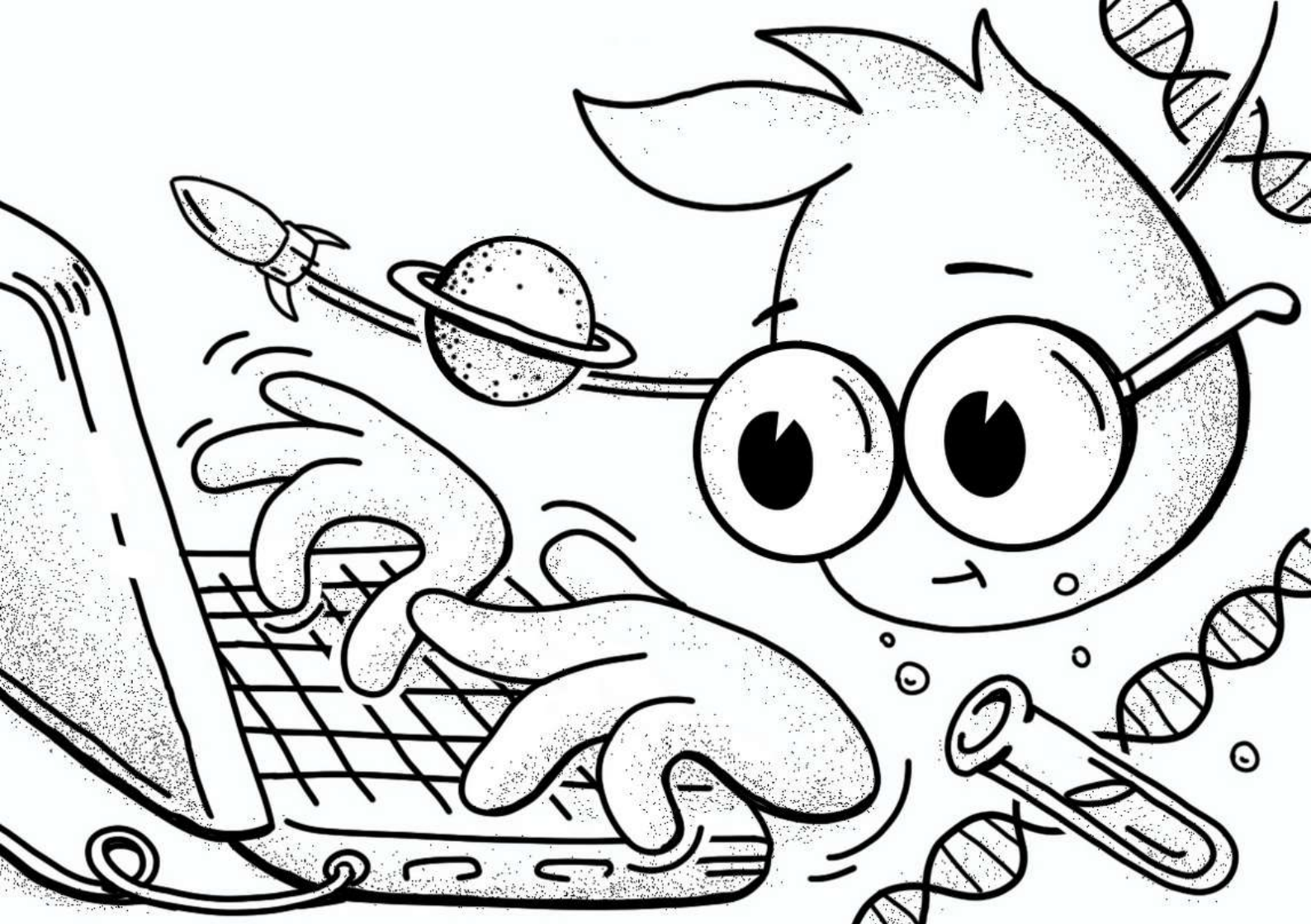


CHAPTER 1
Producing science journalism

How to write a scientific report?
People often get mixed up between different genres of science journalism: opinion writing or commentary, reports and investigative science journalism. It is therefore important to establish what differentiates each type of content before delving into the standards for science journalism**.**

Opinion writing or commentary
Opinion writing and commentary are widely circulated on social media platforms, be it via pictures posted on Instagram or through videos shared on YouTube. Commentary usually conveys the author's own opinion and seeks to adopt certain stances. It will sometimes list data and figures without citation, and without providing a means of verifying the information. As a result, commentary and opinion pieces often lack objectivity and present information that is hard to verify.

Scientific report
Like scientific research, these reports will take a rational approach. A scientific report will first introduce the subject matter, then provide a short history of the issue

and the questions at hand. It will then describe the experiment being conducted, Writing the report also entails identifying the subject's most prominent features, the research method adopted and the findings, which the writer should then analyze in relation to the research questions.

Perhaps among the most internationally renowned scientific research journals are:
Nature (https://www.nature.com/)
Science (https://www.sciencemag.org/)
ScienceDirect (https://www.sciencedirect.com/)
PubMed (https://pubmed.ncbi.nlm.nih.gov/)

Scientific reports and papers are generally considered to provide an exposition of impartial and unbiased information, research findings, as well as the methods used to review and verify them. However, there are a number of fundamental differences between scientific reports and investigative science journalism, which we discuss at a later point.

Investigative science journalism

a. What do we write? Why do we write? Who are we writing for?
Science journalism is a specialized type of journalism to which the following professional criteria are applicable.

Reason for writing:
Are there any new findings or new information that call for renewed interest in the topic at hand?
Example: All the information about COVID-19 calls for careful review and publication, especially since there is local and international interest in any updates about how the virus is transmitted, methods of preventing its spread, available treatments, the feasibility of clinical trials on drug treatments and vaccines, how soon vaccines will be approved, and the differences between what are the differences between the vaccines that are being trialed and evaluated?

Importance of topic:
How significant is the content to your readers?
Example: A topic such as the pollution of the River Nile as a result of chemical waste will of course be of interest

to an Egyptian audience, since the Nile is an integral part of people's lives as a source of drinking water and a resource to irrigate their crops. However, the same topic will not be of equal interest to an audience from a different country.
Here, we can rely on some indicators that help the editor choose their topic:

Timeliness:
A scientific editor needs to make sure that they keep informed of matters preoccupying public opinion at any given time, at the same time as being aware of how able they are to produce journalism that will respond to readers' questions. For example, in order to cover the occurrence of a natural disaster such as a tsunami or a tornado, a scientific editor should be able to explain what these natural phenomena are, why they happen, and what technologies can predict them.

These questions are important right in the moment of a particular phenomenon that's drawing public attention, but they are irrelevant to most people just a few days before or after an event takes place. The same can be applied to occasions of international interest, such as World Water Day, Breast Cancer Awareness Month, and announcements of Nobel Prize winners. It is important, then, for journalists to be trained to prioritize topics according to current events: the more the event or phenomenon has an impact on the readers, the greater the appetite for the topic.

Target Audience:
A scientific editor should be able to identify who their audience is, in terms of age, gender, educational level, and which scientific topics are of interest to them. All of these factors can shape the sphere of the audience's interest and the topics that affect them most directly, as well as having an impact on their preferred writing style and on what type of supplementary visual media will be most appealing to them. If the majority of the target audience are young people and teenagers, for example, they are more likely to be interested in technology, sci-fi and futurology. It is also generally accepted that scientific editors should come back to their readers frequently to check what topics they are interested in, or take note of the topics that are generating the most reads, comments

and shares. Yet, it's also good for an editor to venture occasionally into new topics. If an editor's specialty topics are tech and future studies, they could potentially propose a topic exploring how modern technology is playing a role in football for example, perhaps looking at the manufacture of football and sportswear, football stadium cameras and programs that assess athletes' competence. This approach could attract new readers who are passionate about sports and interested to understand the role of technology in football matches, while it also gives space for standard audiences to explore an array of topics that might not otherwise be of immediate interest, for example: virtual currencies, telemedicine and so on.

Geographical proximity:
People are usually interested in matters that affect their lives or their immediate sphere. A robbery or fire in a back street is more relevant to residents of that neighborhood than news of an earthquake on an island in Japan. By way of an example in Egypt, readers in the country were more interested in following news and reading scientific content and updates regarding Hepatitis C and its treatment than other countries in the Arab world due to the high rates of infection in Egypt. There is a constant demand among readers keen to hear about the latest treatments, how effective they are and how they can be procured.

Relatability:
The simplest way to explain this is by looking at the Nobel Prize. Every year a Nobel Prize is awarded to laureates from the fields of chemistry, physics and astrology, medicine and physiology, literature and economy. Though the awarding of the Nobel Prize every year garners a lot of media coverage worldwide, it was doubly important as a news event in the Egyptian media when Dr. Ahmed Zewail won the Nobel Prize in chemistry. The fact that he was an Egyptian-born chemist made him more relatable, and prompted lengthy coverage of the scientist, his achievements, his history and his family.

How? Why?
Journalists know that a news piece should provide answers to the questions of "who, what, where and

when?" Yet it is also pertinent to enquire as to how, and why. These last two questions are the main points that journalists will focus on when writing an in-depth report. They can do this by holding interviews if the information is easy to get hold of from sources, or if it's less available they can investigate multiple sources in an attempt to produce their own conclusions.
For example, files have been put forward on medical and scientific policy that try to investigate how COVID-19 mutates, why it takes a long time to produce effective vaccines to combat the virus, how research results are translated into products and services that benefit the national economy, and why this strategy is less successful in Arab countries than in more developed countries? Other questions explore why obesity, high blood pressure and diabetes are increasing worldwide? All of these questions may have several answers, prompting distinct scientific investigative reporting

Accuracy and clarity:
Every scientific editor should be well versed on specialty scientific topics and should be able to convey information in simple and accurate language. This can cause difficulties, since every field adopts its own set of jargons that shape the foundations of the topic. You cannot, for example, discuss gene modification and CRISPR / Cas9 technology without prior knowledge of genetic engineering. Likewise, you cannot talk about how black holes are formed in space without reference to Albert Einstein's General Theory of Relativity. A science editor needs to be able to simplify the subject they are tackling without shying away from the meaning of relevant terminology, and without causing inaccurate or erroneous information to be published.

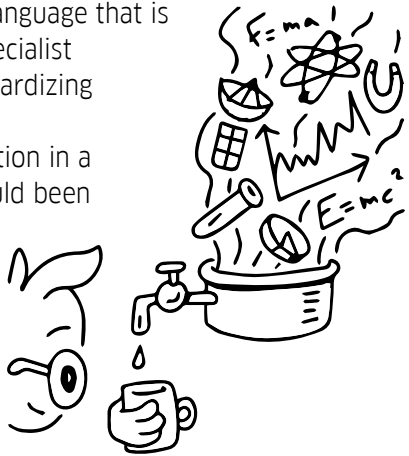
A science journalism editor must therefore ensure:
- Clarity
- Accuracy
- Prioritization of most relevant ideas and concise writing

Science journalists commonly use the inverted pyramid concept to visualize how information should be simplified and results should be presented: items should be prioritized and structured according to importance and relevance, with the newest or most important at the top.

This contrasts with the informational hierarchy used when writing scientific research. A scientific investigative report introduces topics in a simple way, asks questions and provides answers, as well as considering including other background information on the topic (social, economic, religious, etc.) when necessary.

In conclusion, a scientific report is basically:

- A journalistic report about scientific topics
- Relevant to its target audience's interests
- Written in a simple language that is accessible to non-specialist readers without jeopardizing meaning
- Sources and information in a scientific report should been reviewed and verified. That point will be discussed in details in next chapter.



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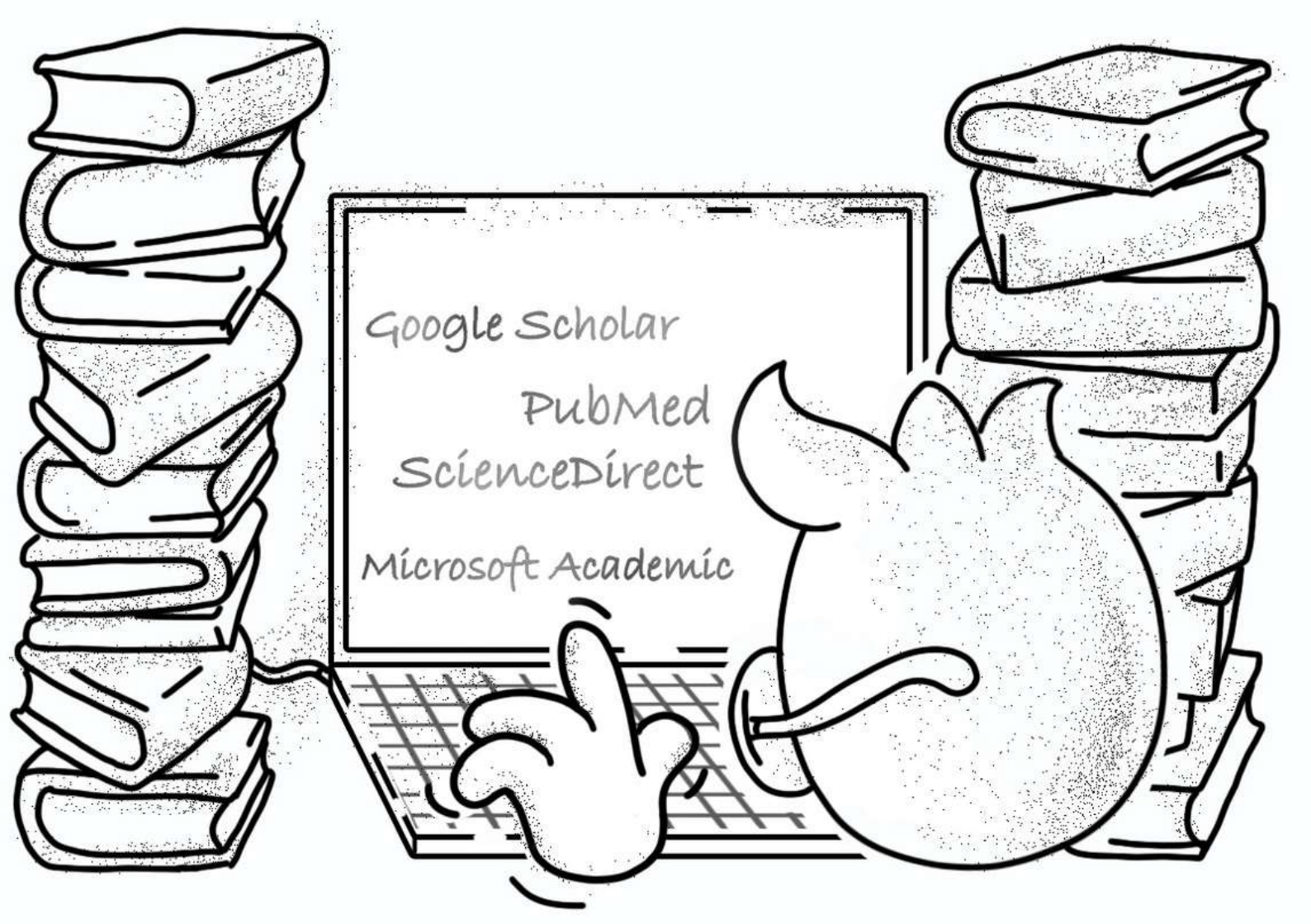
http://www.wfsj.org/course/index-e.html

https://www.scidev.net/mena/journalism/practical-guide/How-to-report-science-of-covid-19.html


Google Scholar
PubMed
ScienceDirect
Microsoft Academic

CHAPTER 2
Sources and references

What are sources?
Data and information are one of the primary foundations of any kind of journalistic writing, including specialized journalism such as economic or science journalism. In order to avoid circulating inaccurate or misleading information, it is necessary to cite where the information is from, so it can be easily reviewed and verified if needs be.
For example, if you are writing about scientific journalism reseach in Egypt, you will need to refer to specialized sources that provide documented information and references.

You could be looking to access information on the annual expenditure of scientific research, the number of researchers in Egypt, on how many research studies are conducted or patents issued, or on how many research institutes there are in the country, and naturally, to answer each question you would have recourse to a particular point of reference.

N.B. We have included online references for journalists at the end of the chapter.

As such, you must cite sources when writing about a scientific topic. These could be institutions specialised in that particular field which publish reports and statements periodically, or they could be people who are experts able to read, analyze and evaluate data, and to whom you can return to check information.

Example 1:
On January 29, 2018 Al-Masry Al-Youm newspaper published an investigative report by Mohamed Mansour under the headline, "The full story behind the discovery of an Egyptian dinosaur in the oases." The report relies on testimonies from the research team in the field as well as on a study that was published in Nature magazine. It also uses pictures and maps to document all the information.
https://www.almasryalyoum.com/news/details/1251978

Though it is common practice to withhold the identity of a source in journalism, when sources are cited in scientific writing it constitutes documentation of the information. Even when the direct source of information isn't provided, it is important for a journalist to elaborate on how the information was gathered, reviewed and verified, as well as the sources they relied on for analysis and how the conclusions were reached. This kind of journalistic writing, which falls under the umbrella of the investigative genre, can do a lot to display a reporter's professionalism, and helps them avoid being accused of publishing fake news.

Example 2:
On November 17, 2009, Al-Masry Al-Youm published an investigation into water pollution in the River Nile coming from the Hawamdia Sugar factory's waste, and on how that was impacting the health of citizens living near the factory. Even though no direct sources were cited, investigative reporters Hesham Allam and Darine Farghaly explained each stage of the investigation, all the sources that helped facilitate the process as well as those that hindered it. It was clear that they had invested a lot of effort on the investigation, gathering information and conducting. interviews in order to reach the results that they did.

This investigation garnered a lot of attention in the media,and prompted a public debate around the standards for the treatment of industrial waste from factories around the Nile.
https://to.almasryalyoum.com/article2.aspx?ArticleID=233547

Example 3:
On July 23, 2014, Al-Watan newspaper published an investigative report by journalist Gamal Mohamed al-Ghettas titled, "Passing and failing in [thanaweya amma exams in the] governorates: Monufiya first place, Matrouh last, Qalyubiya midway"

Contrary to what is commonly written on results every exam season, Ghetas focused on analyzing the information issued by the Education Ministry, which led to a number of conclusions that the authorities usually neglect to mention in their statements and press conferences. The investigation showed the rate of failure in governorates, which subjects the students fail in more often, whether their curricular concentration is literature or science, and rates of students whose concentration is . literature and those whose concentration is science. This indicated disparities in the quality of education in the Delta and Upper Egypt.
https://www.elwatannews.com/news/details/525751

Example 4:
In February 2014, Jordanian journalist Hanan Alkiswany published an investigative report in Al-Ghad newspaper titled, "Scandal of expired biscuits manufactured in Juweidah [being given] to Iraqi children." The investigation revealed that packs of expired biscuits were being sent to children in Iraq within one of the projects of the World Food Program. To verify the information, Alkiswany pretended to be a factory worker and took pictures to document the expiry dates that were being obscured. This piece prompted a wider investigation that probed the United Nations, as well as ensuring that the disposal of shipment of expired biscuits. The reporter received several awards for her investigation, including the International Organizations Award for Defending the Marginalized and the Vulnerable, and the Elizabeth Neuffer Memorial Prize for written media sponsored by the Alexander Bodini

Foundation, which is devoted to coverage of news related to the UN.
http://rasseen.sahafi.jo/art.php?id=9413d5f8021243d0d9ceff796dc90bb814b5954d

https://alghad.com/%D8%A7%D9%84%D8%A8%D8%AF%D8%A1-%D8%A8%D8%A5%D8%AA%D9%84%D8%A7%D9%81-%D8%B4%D8%AD%D9%86%D8%A9-%D8%A7%D9%84%D8%A8%D8%B3%D9%83%D9%88%D9%8A%D8%AA-%D8%A7%D9%84%D8%B9%D8%B1%D8%A7%D9%82%D9%8A-%D9%81%D9%8A/

Building contacts

Reporters work on developing and strengthening relationships with contacts that have expertise, knowledge and information in certain areas, as well as experts who can analyze the data with a great degree of professionalism and objectivity that are of benefit to the journalist and to the general public. Some sources have experiences or a background that enables them to shed light, for example, on the social and economic aspects of a certain health system, or perhaps on how useful a certain digital service is to the general public.

A reporter will get to know their sources by being persistent in attending and following up on conferences and various events. This gives reporters the opportunity to hear about the latest news, to follow specialists' discussions and to get a sense of points of disagreement or consensus; all of these ideas can represent fertile ground for reportage or features. When a reporter is an expert on a certain topic, they become keen to read and follow up on relevant scientific research and reports, as well as on any local and international media covering the topic.

Stakeholders and diversity of information

Other than specialist scientists, there are a number of stakeholders who may have different kinds of experience in a field of interest. If a journalist is writing about a new pharmaceutical drug, for example, they would need to interview the research team that developed it, published

research about it and obtained the patents for it. Such sources would of course be able to provide a lot of of information, starting with the inception of the idea to develop the pharmaceutical compound, the stages of its development, and up until its approval as a treatment for patients.

This would ensure we had a good grounding on the subject, but in order to cover all the angles, other stakeholders, could be interviewed, such as:

- ***Doctors who conducted clinical trials on patients***
  Doctors could talk about the benefits of the drug, its effectiveness depending on demographic factors such as age and gender, whether those patients are in the early or late stages of infection, any potential side effects, effectiveness compared to other medicines, and anyone who should avoid taking it. They can indicate whether it interacts negatively with any other drugs, or point out interaction with certain types of foods that may cause negative effects on patient health.

- ***The pharmaceutical company producing the drug***
  Company representatives or insiders could discuss aspects related to pricing, accessibility in developingcountries at a low cost, and how it compares with generic drugs or drugs that have a similar chemical composition

- ***Researchers and independent doctors***
  Pharmaceutical companies, of course, fund clinical trials and are in contact with the doctors running the trials. This puts medical researchers in a situation where they are faced with a conflict of interest: in their research role they are seeking to assess the drug's effectiveness in coat, and in their medical role the primary concern is the patient's well-being, and it's important to be able to talk openly and without bias about the pharmaceutical products available in the market. During presentations, therefore, these doctors will make sure first to fully disclose their role on a research team conducting trials, as well as disclosing with which company they are affiliated before sharing the results of clinical trials with patients.

It is also important to interview researchers and independent doctors who have conducted these trials without direct communication with the relevant pharmaceutical company and have made their own scientific and medical observations. This can ensure the results match up, and confirm the findings of the initial research team. It can also reveal any clear divergences that would need further investigation. A research team could note a negative interaction with another medicine that patients often take, providing information that can be included in the medicine's leaflet inside the package to alert doctors and service providers and help to save thousands of lives around the world. It is also important for the reporter to verify the credentials of the interviewed researchers, as well as to ensure that they have conducted their clinical trials by following scientifically accredited standards. This will ensure the journalist can avoid publishing false information or data that does not adhere to scientific standards.

- ***The Health Ministry and other authorities responsible for pharmaceutical drug approval and production***
  The views of regulatory authorities are very important, since they are responsible for reviewing results from clinical trials, the quality and efficacy of the pharmaceutical drug, and the precautionary measures taken in its development.

- ***Non-governmental organizations concerned with patient rights:***
  Those organizations also have something to say about the medicine, its price and its availability, especially when they deal with the direct beneficiaries of the treatment

- ***Patent Office:***
  This authority may provide information on whether the pharmaceutical product is subject to intellectual property protections or not, and whether it can be locally developed into a similar drug with another brand name.

A diverse assortment of sources allows the reporter to gather more information, opening the way up for an in-depth discussion of the topic. It also makes way for aspects of the topic other than the scientific to come up, such as social and economic considerations.

Professional standards

A reporter needs to stick to the following standards as their sources increase and diversify:

- ***Targeting experts***

  Before interviewing them, a science editor will often need to find out more about the researchers and their work. A science editor can depend on search engines like Google Scholar to find out more about the researchers, take a look at what they have published, how often they publish, how often they are cited, which journals they published in, and other scholars they have collaborated with. Science journalists can also look up the fields the researchers publish in, use keywords to learn about the most prominent researchers in the field, inferring this information by noting how often their work is cited. Usually, the last name listed is the supervisor of the study, who is often the oldest and the most experienced. The first name is usually that of the researcher who contributed most to developing the study. Other scientific search engines that reporters can rely on include PubMed for medical research, ScienceDirect for scientific research, and Microsoft Academic, which provides graphs and detailed information on research.

Impartiality

Reporters often try to be impartial, and attempt to avoid imposing their opinions or viewpoints on others to leave space for their sources to share their opinions. In some matters however, when sources share scientifically inaccurate information, it becomes unreasonable to allow what they say to go unchecked. If a source were to talk about climate change for example, and were to try and absolve the role people play in contributing to global warming, it would not make sense to give space to the source to speak on the topic given the quantity of material that has been published showing pollutants in the atmosphere cause climate change. Endorsing pseudoscientists, or research that can not be reviewed or verified is not appropriate.

Objectivity and bias

On the other end of things, objectivity in science journalistic writing requires selecting trusted sources that have enough expertise in the field, who will be able to articulate their ideas and discuss them in an objective manner. Scientists could be debating whether it is better to rely on genetically modified or organic agricultural produce. These types of discussions can branch away from science and into social or economic questions The aim of these debates is not to favor one opinion at the expense of another, but to allow the readers to understand, think for themselves and then choose what they see fit.

The next chapter will discuss pseudoscience and the methods of verifying and reviewing the quality of the research.

References:

- Egyptian Science, Technology and Innovation Observatory (ESTIO) that is affiliated with the Academy of Scientific Research and Technology *http://www.asrt.sci.eg/ar/index.php/asrt-departments-2/units/estio*

- Egyptian Patents Office *http://www.egypo.gov.eg/*

- Central Agency for Public Mobilization and Statistics *https://www.capmas.gov.eg/*

- AlphaGalileo is a source for science journalists that keeps them informed about new research before its publication *https://www.alphagalileo.org/en-gb/*

- UN Environment *https://www.unenvironment.org/*

- World Health Organization *https://www.who.int/*

- Egyptian Knowledge Bank
  https://www.ekb.eg/home

- Springer Nature publishing company
  https://www.springernature.com/gp

- Pubmed for medical research
  https://pubmed.ncbi.nlm.nih.gov

- Search engines for scientific studies and scientific knowledge production
  https://www.sciencedirect.com

  https://academic.microsoft.com/home

  https://scholar.google.com

CHAPTER 3
Pseudoscience

Fake News

Fake news is one of the main issues that can threaten a journalist's credibility and the credibility of a media platform. Though this term has been around for a long time, its meaning and connotations are disputed. It is commonly acknowledged that news containing incorrect information gets circulated on social media as though it were the truth, without any evidence to substantiate it. Sometimes, however, a reader will consider a news item that does not fit with their beliefs to be fake news, as Nick Rochlin explained in his research, Fake News: Belief in Post-Truth. Journalism, 'Fake News' and Disinformation (Library Hi Tech, 2017). A Handbook for Journalism Education and Training (UNESCO, 2018) defines "fake news" as at term indicating inaccurate content, comprised of the words "fake" (meaning incorrect news) and "news" (meaning information that has been reviewed and verified) to form a paradox since the former negates the latter. Types of fake news can be divided as follows:

1. Misinformation

Misinformation is usually inaccurate content published without the intention to deceive, often on media

platforms and social networking sites. It could be due to hasty publication without proper time being given to edit the text for spelling mistakes, or without referring to sources to fact check mistakes, or inaccuracies regarding names, numbers, or scientific terminology. Misinformation could happen, for example, if the source of information is a correspondent or a tweet on a news site reporting that an earthquake has happened and inaccurately communicating the number of people injured. This is usually difficult to verify right away, and takes some time to confirm with the responsible authorities.

2. Disinformation

Disinformation is directed content that the writer knows to be factually incorrect, and that is being published with malign intent. It could be a rumor being circulated, or a refutation of other information intended to mislead the public. Disinformation has increased a lot in the last few years, especially with social media taking on a more central role as a source of information and disinformation alike.

3. Malinformation

Malinformation is factually evidenced content published with the intent of purposefully smearing or harming someone. Perhaps the most well-known example in the field of science journalism is when a patient's information is published without their consent. Though the information may be true, publishing a patient's personal data without justification, when it is not in the public interest and without their consent might cause psychological harm to them and those around them, and represents an ethical and a professional violation.

Guidelines for avoiding fake news

A number of authorities have published guidelines to assist journalists and academics in verifying information. These include:

- Journalism, 'Fake News' and Disinformation: A Handbook for Journalism Education and Training (UNESCO, 2018)

- The CRAAP Test, (LOEX Quarterly: Vol. 31 : Iss. 3 , Article 4, 2004) ; a list of five questions developed by the Meriam Library staff at California State University for reporters to ask themselves as follows:
  - Currency: the timeliness of the information
  - Relevance: the importance of the information for your needs
  - Authority: the source of the information
  - Accuracy: the reliability, truthfulness, and correctness of the content
  - Purpose: the reason the information exists

Evaluating Information - Applying the CRAAP Test

Meriam Library 🕮 California State University, Chico

When you search for information, you're going to find lots of it . . . but is it good information? you will have to determine that for yourself, and the CRAAP Test can help. The CRAAP Test is a list of questions to help you evaluate the information you find. Different criteria will be more or less important depending on your situation or need.

Key: ■ indicates criteria is for Web.

Evaluation Criteria

Currency *The timeliness of the information*
- When was the information published or posted?
- Has the information been revised or updated?
- Does your topic require current information, or will older sources work as well?
- ■ Are the links functional?

Relevance *The importance of the information for your needs*
- Does the information relate to your topic or answer your question?
- Who is the intended audience?
- Is the information at an appropriate level (i.e. not too elementary or advanced for your needs)?
- Have you looked at a variety of sources before determining this is one you will use?
- Would you be comfortable citing this source in your research paper?

Authority: *The source of the information.*
- Who is the author/publisher/source/sponsor?
- What are the author's credentials or organizational affiliations?
- Is the author qualified to write on the topic?
- Is there contact information, such as a publisher or email address?

- Does the URL reveal anything about the author or source?
  examples: **.com .edu .gov .org .net**

Accuracy *The reliability, truthfulness and correctness of the content.*

- Where does the information come from?
- Is the information supported by evidence?
- Has the information been reviewed or refereed?
- Can you verify any of the information in anot source or from personal knowledge?
- Does the language or tone seem unbiased and freeof emotion?
- Are there spelling, grammar or typographical errors?

Purpose: *The reason the information exists*

- What is the purpose of the information? Is it to inform, teach, sell, entertain or persuade?
- Do the authors/sponsors make their intentions or purpose clear?
- Is the information fact, opinion or propaganda?
- Does the point of view appear objective and impartial?
- Are there political, ideological, cultural, religious, institutional or personal biases?

- How to Spot Fake News (International Federation of Library Associations and Institutions, 2016); an infographic intended to help academics to determine how accurate a piece of information is by considering the following eight steps:
  - Consider the source
  - Check the author
  - Check the date
  - Read beyond
  - Is it a joke?
  - Check your biases
  - Supporting sources?
  - Ask the experts

Most reference material urges journalists and fact checkers to be skeptical, to question information and check sources. Journalists should adopt critical thinking skills like these in their work to avoid publishing false information. The matter becomes more complex when a science journalist is required to distinguish between scientific research and pseudoscience, while journalists might also find themselves confronting science deniers.

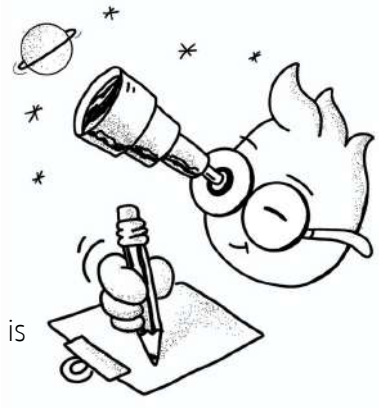
What is pseudoscience?

In Science and Society (Springer, 2015), the writer Eric Swanson defines pseudoscience or pseudo-medicine is "a claim that is presented as scientific when it doesn't adhere to the scientific method," or "any belief held about the natural world with no supporting evidence."

Popular remedies for chronic illnesses published on social media and news platforms are a common example of pseudoscience, while other examples include astrology programs that predict the future by reading zodiac signs and planetary movements,

UFO sightings, doctors claiming to have found a treatment for an illness without providing evidence or conducting clinical trials, and flat-earther groups on social media. These examples tend to base their conclusions on exceptional cases or phenomena, or share nonempirical information on social media platforms without following the scientific method, often driving a wedge between proponents of the ideas and their critics.

British writer and physician Ben Goldacre published Bad Science (HarperCollins, 2008) and Bad Pharma (Fourth Estate, 2012), exploring in both books various stories in which pseudomedicine and anti-science was promoted by interest groups, thus demonstrating the importance of balanced scientific enquiry.



What is science?

There is no one definition for the word science. According to Britannica Academic, science is: "Any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation."

According to the Oxford Dictionary, science is, "knowledge about the structure and behaviour of the natural and physical world, based on facts that areevidence-based, for example through conducting experiments."

The nature of science

Every researcher knows that science is uncertain and that all theories are subject to review and evaluation, scientific knowledge is subject to be changed, developed or adjusted as long as the researchers or scientists pursue the scientific method

It is common for researchers to:

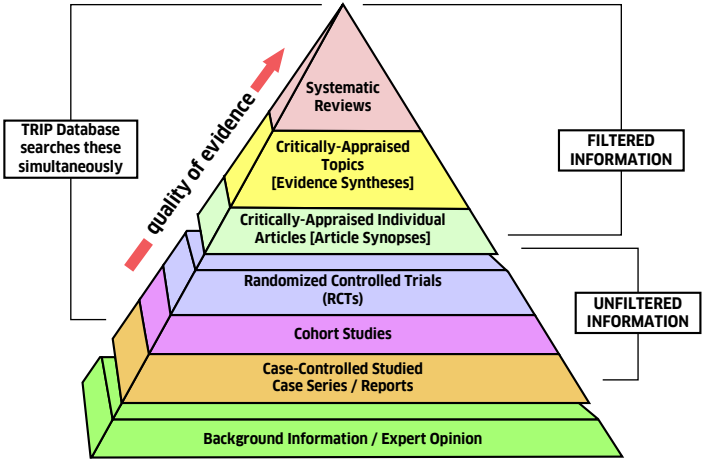
1. Observe a phenomenon in nature
2. Propose a hypothesis
3. Test the hypothesis by conducting a number of experiments
4. Collect and analyze experimental data
5. Reach a conclusion that either supports or refutes their hypothesis
6. Publish the results in order to make it accessible to

other researchers in the field and the general public This sequence of uncertainty and questioning constitutes the scientific method of thinking. The more research results are weighted by new hypotheses and theories,the greater the academic confidence in the results and conclusions.

Can research results be considered “truth”?

In Post Truth (MIT Press, 2018), author Lee McInTyre addresses this by explaining that a scientist’s theory is not "truth" but rather a hypothesis that is strongly supported by evidence and is subject to revision and assessment. Any scientific experiment is also limited by a specific set of criteria, subjects and samples, and therefore does not fully reflect what takes place in reality. There is always an acceptable margin of error in scientific research, and there need not be one single interpretation of any results. A scientist's conclusions must be objective and unbiased. Scientists sometimes observe a relationship between two variables and cannot explain the causal relationship between them, which calls for further observation and experimentation by different labs and research teams around the world, in the hope of reaching better interpretation or of strengthening the existing results. The more similar the results, the more trustworthy the evidence and scientific theory.

Hierarchy of scientific evidence



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As the number of periodicals, research projects and the evolution of medicine over the years, the need for

standardized reference criteria has increased with it and the field of evidence based medicine was founded to promote the application of high-quality clinical trials to reach evidence-based and proven scientific results. The The hierarchy of scientific evidence was designed as a method to rank publications based on the quality of clinical trial based research. Articles and research papers that convey scientists opinions or results from a limited number of clinical trials are categorized at the base of the pyramid. If the quality of the research and the number of clinical trials conducted is higher it will be elevated toward the pyramid's summit. It's extremely important for journalists to use this hierarchy as a reference point to help them recognize which topics are worthy of being reproduced. Evidence and proof are the most reliable tools for journalists who want to refute science deniers and pseudoscience.

How can a journalist avoid fake research?

It is important to be aware that pseudoscience is a current and ongoing phenomenon, and that it will be as long as stakeholders are able to serve their interests through it and as long as it continues to influence the media and society. It is almost impossible to limit the spread of pseudoscience without developing scientific and critical thinking in society, as well as strengthening the role of science journalism.

The most important advice that should be given to science journalists is always to be skeptical of what they read and hear and always to verify information and review sources.

Before citing any research published in a periodical, journalists should follow the following guidelines:

- Review the researcher's professional history to establish how many studies they have published
- Check if the journal or periodical the research is published in is accredited
- Review the title of scientific journal and its popularity according to the following criteria:
  - Is it issued periodically?
  - Is there a committee of academics affiliated with the journal who review the research before publication?

- When was the journal first issued?
- What's the journal's impact factor, how many times has the journal been cited?

A journalist must respond to all these questions, and ask the same questions to the researcher, who will certainly offer support if credible scientific methodology is adhered to in their work. The editor must also seek help from independent researchers, who were not involved in the research, to assess it objectively.

The next chapter will discuss the lessons learned from coverage of the coronavirus pandemic amid scarce documentation and the prevalence of fake news and pseudoscience.

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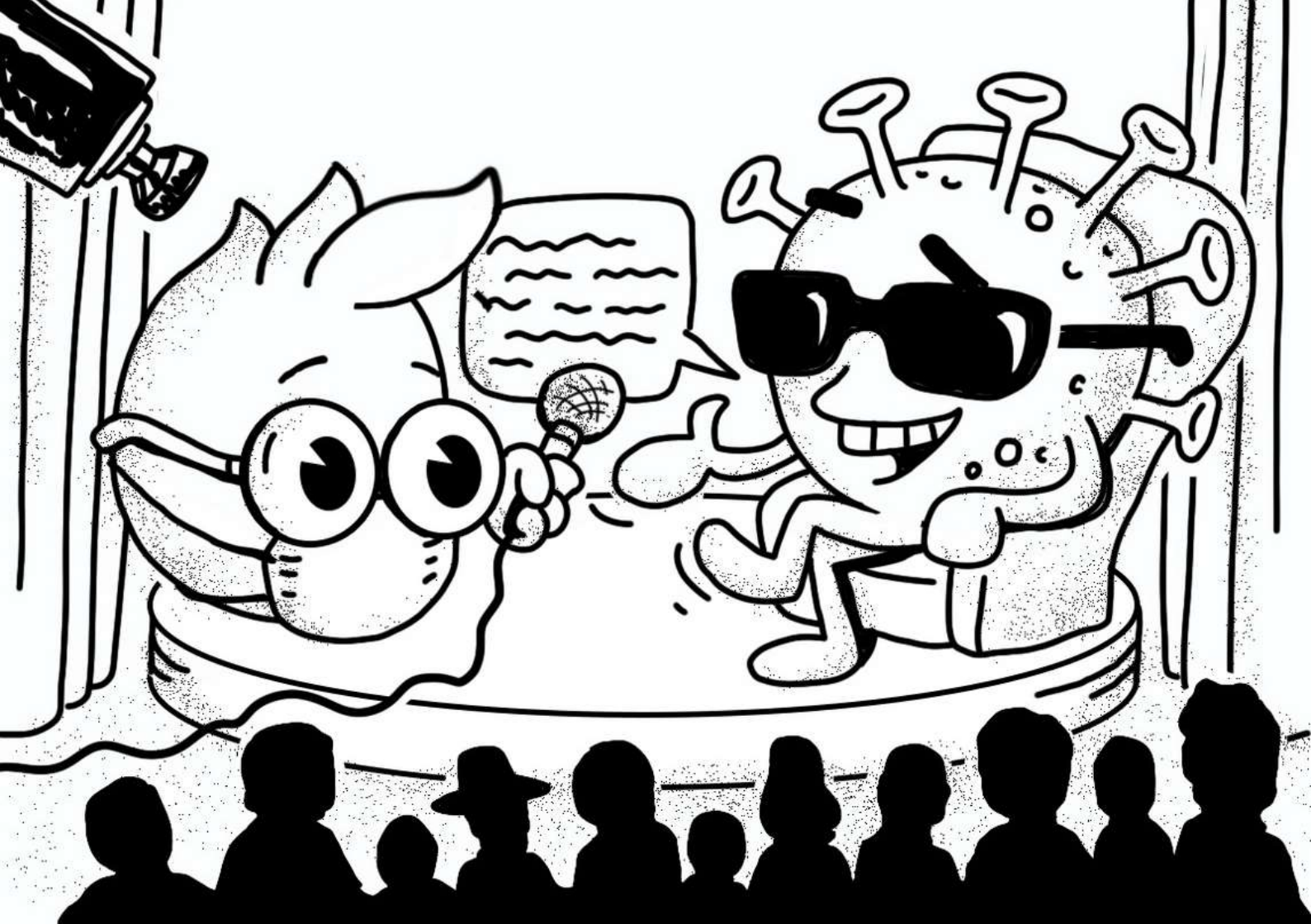


CHAPTER 4
Covid-19 and its implications on science journalism

Introduction

The new Covid-19 disease has caused disruption all over the globe which has altered established routines and norms in the daily lives of the world population. According to the World Health Organization (WHO), more than 63 million people have been infected with Covid-19 and more than one million people have lost their lives (at the time of writing). The "dark" number of unregistered cases of infection cases is estimated as being even larger. While the pandemic is global in its scope, its regional and micro-local repercussions have affected countries in different ways. The slogan "Leave no one behind" seems too idealistic, since the reality shows that vulnerable countries and populations are becoming even more vulnerable, whether through the illness itself or its socio-economic repercussions. One example is the differing mortality rates in countries with similar health systems. Coronavirus has affected all aspects of life: the medical, social, political, economic, psychological, and educational consequences raise questions on the limits of human knowledge, the certainty of our decisions, global and regional injustices and divides, social cohesion and the ethics of the public good. Journalism and

communication have certainly been affected by multi-faceted consequences which pose additional difficulties in an era of crisis narrative and the disruption of journalism.

Covid-19 has two contradictory effects on science journalism:

Firstly, the pandemic is a golden opportunity for public service media since it has increased journalism's relevance for the daily news for average citizens due to the rise of its news values and its direct importance to the audience. Suddenly, science journalism, focusing on medical facts, science innovations and health communication for the public, has the chance to play a starring role. A return to its developmental normative role in Arab contexts has been possible, in order to disseminate correct medical information on infectious diseases and personal hygiene.

The second contradictory effect is that it is precisely due to the rising relevance of Covid-19 news that journalists have been under pressure to cover this issue even if this involved real-life difficulties in accessing correct information or knowledgeable sources. The rising newsworthiness of Covid-19 has meant that pseudo-experts and rumours have been permitted to easily enter the public field. In addition, the social media which challenge the traditional authority of professional journalists are contributing to the rise of conspiracy theories. This highlights the importance of verification and fact-checking journalists who are professionally trained and equipped to provide the public with proper information.

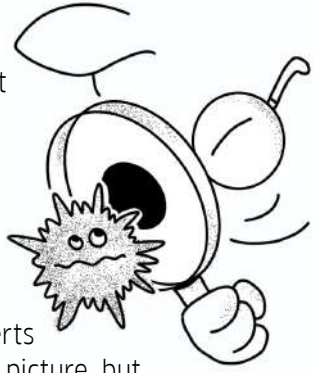
The rise of the so-called "misinfodemic" (Posetti, Bell & Brown, 2020) means that the uncontrollable spread of false information is accentuating but also challenging the role of science journalism during the pandemic. The duty of journalism is to shape public perception of coronavirus, scrutinize the government responses to the crisis, and raise the level of public knowledge about the disease, without neglecting the interactions between journalism and the various digital media platforms - be it social media, search engines, video sharing sites and messaging applications which serve as sources for other kinds of information. It must also counter the various

types of misinformation, working on the basis of data collected by independent fact-checkers (Nielsen, 2020).

Covid-19 challenges for science journalism

Science journalists face multiple pressures and challenges while performing their role:

1. Uncertainties and contradiction of information in daily news production



The novel coronavirus not only perplexes science journalists - it also exposes scientists themselves to uncertain and contradicting data, since the research is evolving daily. This was especially the case in the beginning, when the data range and size were insufficient. Experts and sources didn't have the full picture, but there was still the pressing need to fill airtime and pages and "say something". As knowledge accumulated daily, it was simultaneously being permanently shared with the public due to its extreme relevance and newsworthiness.

Examples of this uncertain and evolving data include the following open-ended questions:

- Can humans be re-infected with Covid-19 or is immunity acquired?
- How effective will vaccines be in containing the pandemic?
- How many strands of Covid-19 exist? How frequently will it mutate?
- Why does Covid-19 affect some people severely while others remain asymptomatic?
- What medicinal care best treats the disease?
- Why do some people recover while others don't?
- How do infection chains start and spread in each country and region?
- Why do the death rates vary so much across countries, even those possessing similar health care systems?

Beyond the medical facts and beyond science journalism, there are further questions of societal, political, and economic importance which encourage science journalists to look beyond the narrow medical facts:

- With the new vaccines on the market, what distribution policies will make them accessible to the global population?
- How can we balance the economy and safety when we impose social distancing?
- What will be the real economic cost of Covid-19?
- How can we counter the misinformation campaigns and conspiracy theories launched through unverified and unchecked information online?

Making sense of these questions can overwhelm journalists, especially when we consider that research cycles are slower than journalistic publication cycles. The friction between the two logics (with science being slower than journalism) creates additional pressure for news media.

2. The need for immediate and urgent information amid lack of sources

The need to research and write news stories while under extreme time pressure and during uncertain times poses an additional challenge. In the Arab context, looking for scoops, changing data and constantly-evolving knowledge exert pressure on daily journalistic work. Covid-19 has shaped the news agenda worldwide, with editorial decisions dedicating full attention to the issue, or on the contrary (depending on the country) putting restraints on press freedom and coverage of the disease. Some medical sources have been forbidden to talk to the press.

3. Limitations of areas of knowledge and expertise

Not all science journalists have experience in covering medical facts: some specialize in education news, some specialize in psychology, while other focus on geology in their work. However, the overwhelming level of attention and the urgent immediacy in addressing Covid-19 news can place journalists in awkward situations where they need to build relationships with new sources, read extra material to grasp the phenomenon, or in the worst case be unable to write adequate stories at all. In this case, the difficulties can be alleviated by teaming up with fellow journalists and relying on trustworthy and helpful sources who suitably break down their findings, and of course through independent learning via exposure to trustworthy and serious sources .

(→see the chapter Sources in this manual)

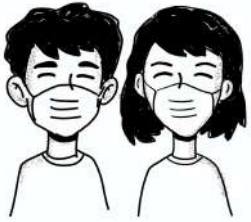
4. When politics interferes with Covid-19 coverage

Political constraints on freedom of speech create difficulties in reaching out to sources. Several journalists in Arab countries say that official sources are not cooperative and only share rigid press releases. In other, harsher cases, journalists have experienced harassment from the authorities for telling deviant facts. However, there are excellent investigative initiatives and cross-national collaboration projects in progress, which require a longer time to produce.

Social stigma and exaggerated phobia of the infection has caused some people in Arab countries to hide the fact they were ill in the first place. The security-driven logic in handling eruptions of social unrest adds further challenges for journalists covering the pandemic.

5. The challenge of misinformation and the need for major fact-checking initiatives

Establishing authoritative and credible information through science journalism is harder in an era of misinformation, increased fact-checking and pseudo-science (see Pseudoscience in this manual). Amid a rising climate of fear, hate speech and xenophobia are on the increase in media coverage in polarized countries. It leads to the blaming the other groups for the spread of the virus. One prominent example is how US President Trump continues to frame the pandemic as being caused by the "Chinese virus". Journalists should not blindly copy such lines, which spread hate speech and discriminatory language. Indeed, journalists have expressed a growing need for advanced fact-checking procedures. The other side of the coin is the limited trust and media credibility in Arab countries and worldwide, which limits journalists' outreach.



6. Concerns for the safety and security of journalists during coverage

Illness and deaths are a real physical

threat for journalists doing their jobs. The risk for journalists of being exposed to people and events while covering the stories cannot be underestimated. Hundreds of journalists have fallen ill and even died in the process, a fact that is often overlooked. Employers and politicians have a duty to enforce regulations and precautions to protect journalists.

Journalists also express the toll the pandemic takes on them in terms of their mental health and burnout issues - they don't have the luxury of being able to avoid the news.

Journalism can improve the Covid-19 coverage

One major widespread inaccuracy in Covid-19 coverage has been the focus on the absolute numbers while not contextualizing the numbers of positive Covid-19 cases within their social, cultural, and political contexts. Giving the proportional numbers of Covid-19 infections changesthe evaluation of the situation completely with regard to a country's management of the crisis.

Journalists should balance the human-interest angle with the medical facts, in accessible language. Increasing the fear level only backfires and leads to the avoidance of news.

The pandemic represents a chance to critically reflect on news values, such as conflict and celebrity bias in current media coverage.

Opportunities of the crisis

Despite the challenges it has given rise to, Covid-19 has had numerous positive knock-on effects on science journalism. Societies have now realized the increased need for accurate information, and this constitutes a silver lining of the crisis. At the same time, however, audience surveys show that pandemic fatigue and news avoidance are occurring as people state that news is adding to their anxiety (Reuters Institute, 2020). As the public needs accurate, professional research and fact-checked information from credible sources now more than ever, the pandemic is a reminder that sustaining independent journalism is vital.

In addition, the focus on the niche area of specialization

of science journalism offers additional opportunities and exposes the dire state of Arab science and science journalism. Good science journalists in the Arabic-speaking media landscape are still rare. Despite the boom of Arabic content in science journalism and science communication in the last decade, they are not part of the daily dose of mainstream news. Future and junior journalists can develop their skills to fill this gap.

Finally, despite the lingering effects of the Covid-19 crisis on journalism, there are also positive outcomes. Intensive international networking and intensive outreach through public webinars are important by-products of the pandemic. Increased transnational collaboration among Arab journalists through social media is building on earlier initiatives such as the ARIJ network. The promotion of transnational journalists' networks though social media has enabled journalists to network and read each other's work, connect, and exchange professional advice amid political constraints in the Arab region.

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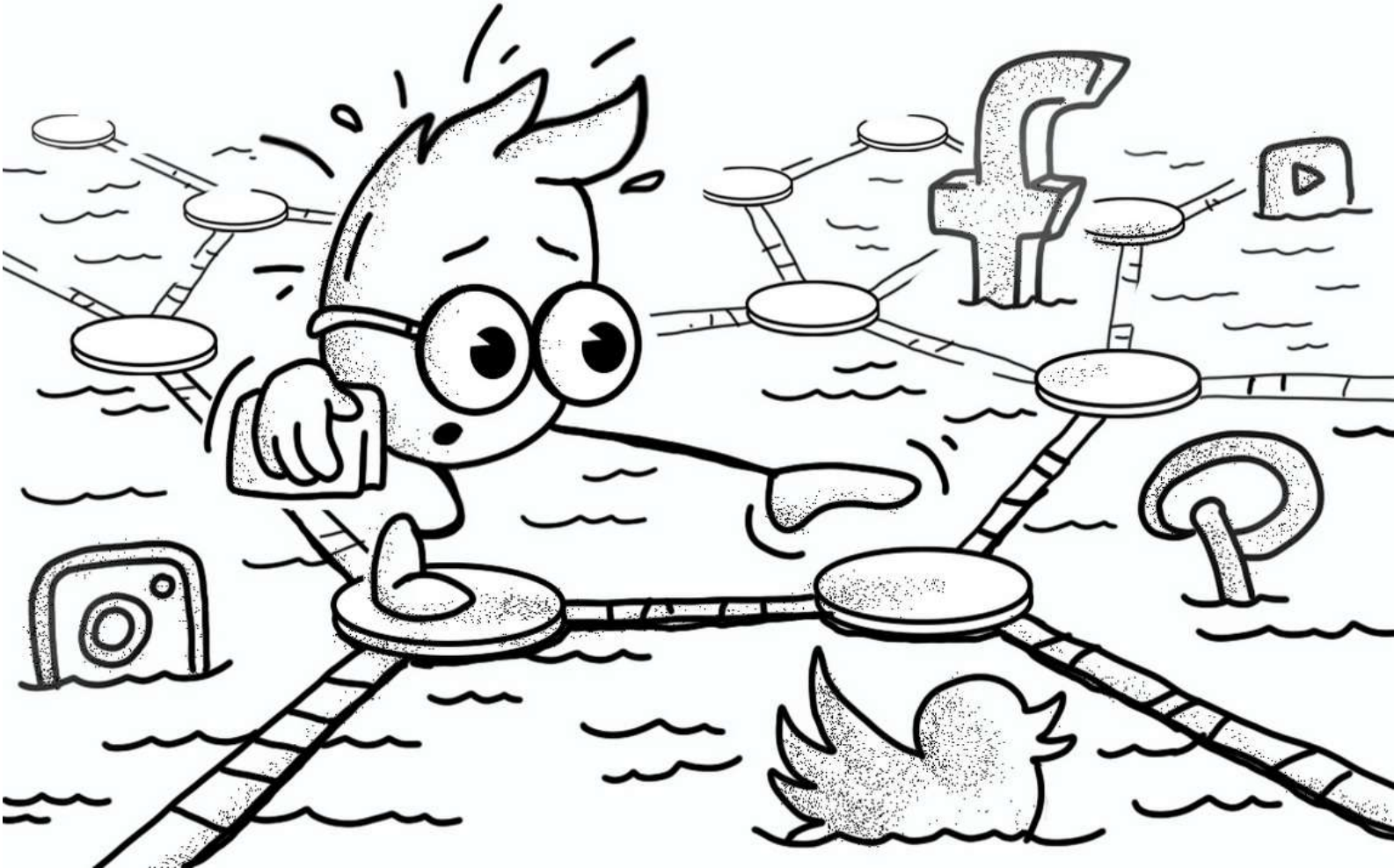


CHAPTER 5
Translating scientific terms

Common errors

After discussing most of the issues related to scientific content and its quality throughout the chapters of this book, it is necessary not to forget language as the "vessel" for these ideas. As a matter of fact, there are successful projects in the Arab world for translating foreign scientific essays, and several periodicals such as Nature, National Geographic, and Scientific American. Many Arab presses and journalistic institutions translate books about the popularization of science, as well as scientific articles and journalistic stories previously published in foreign periodicals so that the arab reader can follow the latest international scientific research and discussions.

Regarding that most - if not all - of scientific content is written and circulated in the English language, everyone who writes or talks about science in other languages faces a daily and continuous challenge in searching for terms in their own languages that discuss and explain the meaning and significance of new scientific terms written in English.

In an article by Dr. Magdy Said, published on September 7, 2015, on Masr Al Arabia website, he said that not only science journalists but a lot of practitioners from different fields are concerned with simplifying science and spreading scientific culture. Some professionals are concerned with scientific awareness, Science Outreach, popularization of science and Science Communication. The different practitioners are working hard to raise the role of science in society and its renaissance and thus It is difficult not to agree on a single term in the Arabic language when dealing with a scientific phenomenon or theory.

As Dr. Ihab Abdel-Rahim in the book The Arab Journalist Handbook, the translator's task is to acquire sufficient experience and skills that enable him/ her to understand the linguistic and scientific meaning of the term written in its first form and to work - depending on the second language and its vocabulary - to produce a term that achieves "perfect reporting and good reception" that is to guarantee Speakers of that language understood the term and its meaning as intended in the original language without prejudice or detraction.

Additionally, the science editor who publishes his topics in various media outlets and is keen that the information should arrive in a simple way, which puts him/her in a new dilemma between the accuracy of the translated term, which may be incomprehensible or palatable, the dilemma of the non-specialized public and the simplification, which may be scientifically inaccurate according to the opinion of specialists.

In an article titled "The Arabic Language as a Scientific Tool" by Dr. Ali Mustafa Musharafa, Professor of Mathematics and Physics at Cairo University, published in the Cairo Resala Magazine in 1933, he addressed the problem of: "Many scientific connotations do not have verbal formulas, and some of the connotations have formulas that are either weak or invalid. Also, in some cases, there are multiple forms of the same meaning, which leads to a kind of chaos in our scientific literature that we must avoid".

In his article written nearly ninety years ago, he urged the formation of committees of specialized scholars and linguists to translate and introduce terms. Dr. Musharafa

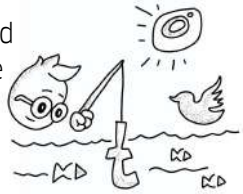
adapted the idea of using a foreign term in our language "after it has been modified to conform to the taste and standards of the language under the conditions that this term is used in all or most of the other scientific languages, and such terms are often derived from Greek or Latin origin. We are in no fault if we derive our terms the same way as others did".

In fact, despite the old age of Dr. Musharraf's article, translating scientific terms still is a major challenge for all science editors, especially if their daily work requires diligence within a few minutes to translate the news and its scientific terms. In general, science journalists rely on several paths to reach a clearer and more accurate translation of the scientific term, which contributes to its ease of use in the media and the localization of the term.

Paths for scientific translation

First: If the source of the news is a research institution or concerned with science policies or industrial and technological companies, press releases may be issued in several languages, including Arabic, and thus the journalist can read the translated term and compare it with the first term in the text written in English and assess the extent of the term's suitability to the audience of readers or requires search for an alternative term that is suitable and understandable to your readership.

Second: The editor can refer to translation dictionaries and specialized scientific dictionaries according to the scientific topic that he is translating. It is definitely better than referring to Google translations. In addition, the journalist can refer to the initiatives of several international and regional entities to provide interactive sites for scientific terminologies translation, such as: https://unterm.un.org, of the United Nations, which provides translations for several languages, including Arabic, for all political and scientific terms circulating in the United Nations sessions and publications. There is also a website http://www.arabterm.org of the Arab Organization for Education, Science and Culture (ALECSO) with the support of the German Foundation for International Cooperation. This site includes translations of scientific terms in four languages: Arabic, French,



German and English. There are also multiple departments for basic and applied sciences and technology industries. With the aim of unifying the scientific terminology associated with the pandemic, ALECSO issued a reference for all scientific and medical Arabic terms related to the Covid-19 epidemic.

Third: The editor can refer to translated news agencies when announcing the Nobel Prize winners and their scientific achievement. The editor does not necessarily use the same terms, but it will be a guided step on the way to searching for a suitable term for the readers.

Fourth: It is important for a science journalist to have a list of reference sources from specialized scientists in order to refer to them and discuss with them not only in scientific topics and news but also in new terms, as this type of brainstorming helps in reaching the appropriate term according to the nature of the topic. The same discussion is carried out by science journalists with their peers within press institutions or through social media platforms.

Here you will find links to a number of reference sources that can help you in your journalistic mission in scientific writing, which represents a renewed river of ideas and knowledge.

Reference resources for technical translation:

- Arabization Coordination Office, Arab Organization for Education, Culture and Science
  http://www.arabterm.org/index.php?id=41&L=1

- The ALESCO project to translate scientific terms related to the Covid-19 pandemic
  http://www.alecso.org/nsite/images/pdf/6-5-2020.pdf?fbclid=IwAR1T0qrGrtIcVlxO2oSzs9CEDf0T1MIrC7r6ybFzf5pEKFSYrEd5Y94g3us

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CHAPTER 6
Science journalism and social media

Social media represent a serious challenge for traditional journalism, competing with it and professional journalists alike. Social media is free, simple to use, and anyone can participate in the conversation. It is ubiquitous and always just a click away. This is a democratic premise which builds the legacy of social media and has made it go viral, but at the same time it also represents its weak spot. Anyone can write anything about any topic - even in the absence of correct information.

Journalism faces numerous challenges in today's hybrid media environment, which combines offline and online media outlets in a globalized world. The rise of the Internet and user-generated content on social media, blogs and other platforms has given actors and emerging actors the chance to co-shape the information environment we live in. They are not only disrupting traditional journalism and news flows: they are actively shaping new conversations and experiences.

Social media adds to the uncertainty of global journalism. Global patterns of media use show that the young generations (so-called "digital natives") are drifting away

from traditional journalism and traditional media sources and are moving towards online and social media. A global snapshot from the most recent Digital News Report 2020 shows this in numbers (Reuters Institute, 2020, p. 24)

> "Across all countries, just over a quarter (28%) prefer to start their news journeys with a website or app, followed by social media (26%) – up two percentage points on last year. Once again, though, we see very different patterns with 18–24s, the so-called Generation Z. This group has a much weaker direct connection with news brands (16%) and is almost twice as likely to prefer to access news via social media (38%)."

A worldwide drop in newspaper use is also apparent in the last decade. In Germany, for example, the numbers of journalism readers dropped from 63% in 2013 to 33% in 2020. At the same time, the numbers of social media users doubled from 18% in 2013 to 39% in 2020 (Reuters Institute, 2020). The number of social media users is higher in countries with large young demographics, less-established reading habits and weak traditional media systems. Comparable results confirm this: in Egypt, only 7% of young people below 25 read newspapers, according to a recent Baseera poll. In the Egyptian context, social media has started to gradually replace and substitute traditional news media, which have been weakened due to political and economic factors. These factors cannot be attributed to economy and technology. The crisis has an overlooked cultural aspect which relates to the value and relevance of the offered information.

From a euphoric promise to dark participation

The Netflix documentary The Social Dilemma, based on interviews with several whistle-blowers from the IT, AI and data industry in Silicon Valley, investigates the question of why social media are so addictive. Social media are designed to exploit the functioning of the human brain. The interactivity and positive reinforcements through comments and likes lure users into constant engagement. The longer social media grab the attention of users, the more profits the big tech companies make. While social media initially was welcomed as a possibility to integrate all citizens into a utopian public sphere, where values such as inclusion, equality and rationality of communication were

welcomed, reality developed in a different direction: commercialization, surveillance capitalism and using the users' data for financial gains.

At the same time, user-generated content without proper moderation turned the participation into 'dark participation' (Quandt, 2018), which refers to the negative consequences of communication, including hate speech, populism, and inciting violence. Balancing state intervention and regulations from above with media freedom and accountability from below is a delicate tightrope act: the regulation of social media must not limit the scope of freedom or turn into censorship. Critical awareness is growing, but it is still not enough to transform the current media environment. The liberal response is to strengthen journalism structurally and culturally in order to restore its relevance and to build on interdependencies with fluid social media without however neglecting the normative frameworks which guide journalism. Audience engagement on social media is a product of journalistic content produced by media organizations who invested capital in it. Sharing and re-sharing them on social media neglects the fact that original contents were produced by journalists. Draft legislation in Australia proposes that the digital platforms should pay for news they circulate on their media. This is a controversial and ongoing debate which will entail financial consequences for platforms such as Google, Facebook and YouTube. The legislation drafts the new financial business model which might represent salvation for traditional journalism: major media corporations are demanding that the money go into a public journalism fund which supports professional journalists (The Guardian, 2020). The next years will bring the answers to these open questions.

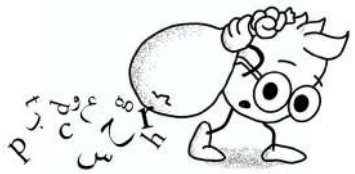
Beyond the crisis narrative

If journalism wants to retain its societal relevance and claims on authoritative knowledge, it must respond to the challenges posed by social media (Usher, 2016). New journalism models are turning away from traditional objectivity norms and openly embracing normative biases and positions to survive and change their readership into subscription communities (Mir, 2020).). This emulates the psychological bonds which social media users feel with their like-minded peers in the networks,

adds a sense of belonging and affirms the cognitive bias which is the lifeblood of social media. At the same time, this new business model is still in its infancy, with only a few best- practice examples worldwide which do not yet demonstrate long-term sustainability.

What does this mean for science journalists?

- The traditional role of journalism is to reduce the complexity of the audience's world, and no social media can claim to achieve this. As audiences always need guidance in their daily lives, they will always require sources of information where they can find it. Science journalism has a niche market and has great potential to fill this gap.



- Science journalism has a unique position in the media environment because it attracts interested non-sensationalism driven readers. It addresses a vast area of topics which connect to daily life, including medicine & health, technology & innovation, psychology & mental health, climate change & environmental awareness, and much more. This diversity and relevance are unique strengths of science journalism. One example of a promising recent trend is the current Covid-19 pandemic, which has reminded people that traditional news sources, including science journalism, are important for the public (Reuters Institute, 2020). Journalism's value for the public good is being better acknowledged, and the for the first time a trend to pay for news has gained traction in the Western countries. As scientific topics need specialized expertise and authentic knowledge, science journalism is contributing to fighting the disinformation and misinformation prevalent in social media. Fighting fake information and misinformation is relevant to science journalism, as the article on pseudoscience in this manual shows.

- The boom of Arab science journalism and science communication and its large reader and fan base (especially among young readers) is a promising trend. This boom is surprising amid the atmosphere of crisis enveloping traditional journalism. However, structurally speaking, it should be noted that most serious Arabic-language science journalism outlets are

often initiatives which are funded through media assistance programs or backed by large international publishers who finance the Arabic language content, who can invest in and sustain the Arabic versions. It remains to be seen whether demanding payment from audiences can guarantee success.

- A symbiosis exists between science journalism and social media. It relies on successful initiatives in social media from non-journalists who migrated to the journalistic sphere or even those from showbusiness entertainment. Starting off in social media communities, an initiative such as El-Da7ee7 managed to institutionalize itself and has convinced investors in the media industries to produce a professional show.

What can social media contribute to science journalism?

It's true that social media has disrupted journalism on the structural macro level. However, on the day-to-day level, science journalists are experiencing several benefits when using social media:

- It helps journalists find sources and establish contact with them in faster and easier ways.

- Being globally exposed to a constant flow of information stimulates new ideas. This inspires journalists with new news stories and ideas and also helps journalists to showcase their work and build a visible online portfolio.

- Additional interactivity with the audiences enables journalists to see what kind of buzz a story creates or what triggers the readers and encourages the former to pursue their agenda and respond to public demand.

- Social media is connecting science journalists in informal transnational networks.

Science journalism can support the fight against online misinformation. Debunking factual fabrications and myths can be of use to the social media platforms themselves. Social media corporates are supporting journalism through initiatives driven by Google and Facebook to show their commitment to truth.

Conclusion

This article does not seek to build binary logics of an either/or scenario of journalism or social media. On the contrary, it seeks to build synergies. It seeks to highlight the current dilemmas and the paradoxical yet symbiotic relationship between social media and science journalism. Several possible points of cooperation are feasible: traditional media use social media for outreach to the audience, and social media lives from debates and content created by journalism. The requirements on journalism today are definitely not to shun the new possibilities of interactivity and audience engagement by branding their actors as laypeople, but rather to connect to the public debates and use the interactive tools to strengthen its position and transform itself in a ubiquitous experience. The unique specifics of science journalism, namely expertise, highly specialized contents and niche audience of interested publics, can turn this branch of journalism into a 'destination' where readers go to engage and hang out.

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