Writing for lay audiences: A challenge for scientists

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Abstract

Writing for lay audiences, especially lay summaries, is needed to increase health and science literacy, but this kind of writing can be difficult for scientists. The article describes why it can be so difficult and gives some advice on how scientists can cope with the challenge and how institutions and organisations can help.

Keywords: Lay writing, Lay audiences, Lay summary

Changes in media landscape have made specialised information readily accessible to the public and have allowed companies and organisations to advertise their products widely. Healthcare providers, research institutions, and individual scientists have found electronic media an effective way of educating and informing, that is, to 'market science by one click'.[1]

The ability to write for lay audiences is increasingly important for scientists. For example, the PLOS journals publish non-technical summaries for peer-reviewed articles[2] as part of their commitment to public engagement. Public funding bodies and charities also require lay summaries for grant applications[3] because they recognise the importance of having lay audiences evaluate whether they are funding research that corresponds to the needs of their members.[4] In addition, some research organisations have blogs to inform and update the public and express opinions about certain aspects of research not necessarily discussed in scientific papers. In this way, organisations help the public to better understand science, while increasing their social media presence.[5] A quarter of scientists blog for the same reasons.[6]

Involving the public in this way can improve the quality of research and help develop new research strategies.[4] This process also aids in transparency, which is not only an ethic issue[7] but can also facilitate interdisciplinary research.[2]

Why it is difficult for scientists to write for lay audiences

Many academics find it difficult to write for lay audiences.[8] Not everyone can blog like Martin Robbins or write informative pieces for lay audiences like Stephen Hawking or E.O. Wilson.

Specialised knowledge and language

A scientist's specialised knowledge is often a hindrance to effective lay communication.[9] Effective lay communication requires that the expert anticipates the audience's knowledge or perspective on the subject.[10] Scientists are trained to publish scientific papers and to discuss findings with peers, which often makes them unable to understand how others think.[11] A study by the Royal College of Practitioners (RCGP) in England showed that about a half of adult patients do not understand the verbal advice given by doctors even if it is supported with written patient information.[12] In fact, much patient information material is criticised for not serving its purpose.[13,14]

Another problem is that scientists often use specialised language or jargon because they fear being inaccurate.[3] The use of jargons is of course discouraged in lay communication because lay audiences find jargon difficult to understand and confusing. However, whether a word is jargon or a standard term can sometimes be difficult to determine.[15] For example, words like *acute*, *chronic*, and *significant* can be considered jargon because not everyone truly understands what they mean.[16] Also, some expressions can be misinterpreted by lay audiences, for example, *positive correlation*, which may be interpreted as something good.[17] Other words that might be interpreted differently by scientists and lay audiences are listed in Table 1.

Some words are not easily expressed in simple terms, such as *nitrogen fixation* and *oxidation*.[2] Also, doctors and scientists have a distinct writing style, as shown by their use of prepositions and articles, such as in the examples below:[16]

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- *treatments working in patients* instead of *for patients*
- *drugs used in hypertension* instead of *on/for/against hypertension*
- *bacteria that are deadly in mice* instead of *to mice*
- *prospects for recovery after stroke* instead of *prospects for recovery after a stroke*

Expressing statistics and uncertainty

Also, scientists are used to expressing uncertainties or demonstrating validity through statistics, which can be hard to translate in lay language. For example, *a slight but statistically significant ($p = 0.001$) difference in growth rate* is difficult to express in lay terms. The problem gets worse if the results are conflicting and a straightforward conclusion cannot be drawn. Although most lay readers have no knowledge of and are not interested in statistics,[18] many scientists find it difficult to leave out such details, feeling that they are necessary to accurately transmit their message. Science journalists, who often act as bridge between scientists and lay readers, have often been criticised of oversimplifying or even filtering information.[8,18] For instance, *could*, *might*, and *may* are not necessarily good substitutes for carefully formulated statements, and *powerful evidence* or *a breakthrough* can sound exaggerated.

Risks of generalising

As a result of generalising and leaving out details, information can mislead. This is a concern for 'broad collective citizen participation'[19] because the public might negatively react or overreact to a new finding. For example, a discovery in medicine may be misinterpreted to suggest that a cure to a disease will be soon available,[8] or a new virus might be hyped and cause unnecessary panic. On the other hand, some say that scientists are partly to blame for the public's confusion and indifference about climate change; they say that the use of too many levels of likelihood terms (*likely*, *unlikely*, and *most likely*) makes climate scientists sound unsure of themselves.[17] This can make the dissemination of scientific information counterproductive.

Heterogeneous audience

Lay audiences are heterogeneous. Scientists find it easier to write for peers because it is easier to focus the message. A lay audience is a mixture of different ages, cultures, professions, and socio-economic backgrounds, each with its own 'language'. In many cases, the lay audience is poorly defined[4] so that the scientist is left groping in the dark.

A culture of exclusivity

Some scientists are guilty of intentionally writing 'abstrusely…to prove their intellectual superiority',[3] and some think that what academics write does not have to be understood by everyone,[20] quoting Stephen Jay Gould, 'science selects for poor writing'.[3] For example, although many scientists blog to bring science to the public, others find 'writing for masses' a waste of time[21] or think that lay summaries are not 'a good use of a researcher's time'.[2] In a discussion in Research Gates' online forum on the difference between writing a textbook and a peer-reviewed article, one of the respondents admitted that writing a textbook was one of the most difficult accomplishments he had had. However, whereas 'anyone' can write a textbook, few can publish in high-impact journals.[22] This greater emphasis on peer-reviewed articles highlights the special 'culture of exclusivity' around academia, which is strengthened through the 'publish-or-perish tenure process'.[21] Writing for lay audiences can therefore be 'professionally risky'[23] and have little incentive for scientists.[6]

What to do about these difficulties

Common writing tips

For scientists who see the importance of lay communication and do not consider it a 'sacrifice' of

Table 1: Scientific terms that have different meanings for lay audiences

Scientific term	Meaning for lay audiences	Suggested equivalent for lay audiences
Significant	Important	Did not happen by chance
Fraction	Small part	A part
Trauma	Psychological event	Physical damage
Enhance	Improve	Intensify, increase
Positive trend	Good trend	Upward trend
Positive feedback	Good response, praise	Vicious cycle, self-reinforcing
Theory	Hunch, speculation	Scientific understanding
Uncertainty	Ignorance	Range
Error	Mistake, wrong, incorrect	Difference from exact true value
Bias	Distortion, political motive	Offset from an observation
Values	Ethics, monetary value	Numbers, quantity
Scheme	Devious plot	Systematic plan
Anomaly	Abnormal occurrence	Change from long-term average

Based on Freeman[16] and Somerville and Hassol.[17]

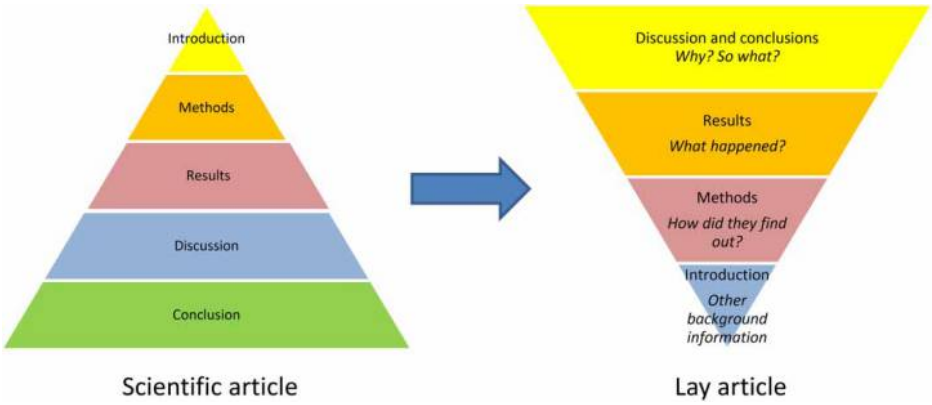

Figure 1: Structure of scientific articles and lay communications. A scientific structure has a pyramid structure in which the information starts with an introduction and ends with the discussion and conclusions. In contrast, a lay summary has an inverted pyramid structure in which the reader is first told about the conclusions and is then led in the opposite order to the more detailed background information. In this way, the interest of the lay reader is captured, and the interest is held while they are informed about the details of what happened, how they found out, and other aspects of the background.

their academic performance, there is much advice on how to write for lay audiences.[24–26] Common tips include:

- Avoid jargon
- Exclude details that may not be interesting for the readers
- Use plain language (see also issue 24(1) of *Medical Writing*)
- Use the active voice
- Use visual aids

Identify what the reader needs to know

Heterogeneity of the lay audience is a difficulty, so it is advisable to at least identify what is important for the lay reader to know[26] and to provide this information.[3] Technical writers who write instruction manuals expect that readers want to know how a product is used. Therefore, for a manual to be user-friendly, it should contain step-by-step instructions with short and simple sentences and well-labelled pictures; detailed information about the properties of the product is found somewhere else. On the other hand, lay summaries of research proposals should answer '*So what?*' or '*Why* is the research important?' instead of '*How should the research be conducted?*'[27]

Identify the reading level of the audience

If possible, the age group or reading level of the audience should be identified.[28] Readability calculations are based on several readability statistics, each of which has pros and cons.[28,29] Readability can be computed manually or with word processing software (e.g., MS Word, Open Office) and online word processors such as Google Docs.[28] All readability statistics only provide an idea of complexity or wordiness and do not assess the effectiveness of your writing because they are 'insensitive to meaning or intention'.[30] Nonetheless, they can be a good indicator of how well your readers can follow your text.[28]

Make your writing interesting

Tell your story with enthusiasm – share your knowledge in a compelling way.[11,25,26,31] One idea is to write using an inverted pyramid structure, wherein the article starts with the conclusion and discussion (as they contain the most important message) and end with the introduction or background information (Figure 1).[25,26] Writing plainly on *what, who, when* and *where* can be dry, whereas answering *why* and *so what* can make your writing more compelling.[27]

Other tips

Other good tips include reading your text aloud to non-specialists and using their feedback to detect jargon and other forms of inaccessible language.[4,23] Remember also that 'practice makes perfect' – your lay writing skills will improve over time.[23]

Role of scientific and funding institutions

Many efforts have been made to improve communication targeted at lay audiences. For example, to address the problem of jargon, many organisations publish a glossary of lay terms. Organisations should cooperate to standardise their glossaries to avoid contradictory information, facilitate sharing, and improve usability.[4]

Guidelines and guidance notes

Guidelines or guidance notes are available from most organisations requiring lay summaries, such as the Asthma UK Foundation and the Muscular Dystrophy Campaign.[4] These guidelines include not only information on content and structure of lay information but also instructions on what language should be used (e.g., UK English or plain English), as well as details on punctuation and spelling, use of active voice, and appropriate tone. Each organisation should develop its own guidelines to meet the objectives of its lay texts. The size limit of lay versions is not always provided and can vary. For example, the UK Research Councils permit 4000 characters, the Stroke Association allows 1000 words, whereas the Proceedings of the National Academy of Sciences of the USA allows only 120 words and the British Heart Foundation allows only 100 words.[23,27]

Templates and forms

Templates and forms are also very helpful in writing for lay audiences. The Stroke Association requires that lay summaries answer the questions that lay people have about the research.[4] To achieve this, they provide forms with questions of interest to a lay person (Figure 2).

Evaluation of lay material effectiveness

Writing lay summaries and patient information materials are useless if they are difficult for the target group to understand. Organisations should provide a means for lay audiences to evaluate written materials.[4] Although most organisations provide a 'comments' section, the wide variety of responses can be difficult to evaluate. Organisations should instead use surveys, interviews or easy-to-use feedback systems to gather measurable information on how understandable their lay materials are as practised by some US CDC offices.[32] This may also help to avoid the current mismatch between readability level and literacy skills.[28] The US CDC measures progress made in production of lay materials through feedback from lay audiences and regular reports from its staff on the changes.[32]

Different levels of information

Content of lay materials should be produced at several readability levels.[2] Also, different lay audiences require information to be presented in different ways.[3,6] Some museums have several types of audio guides available not only in different languages but also for different age groups (children, teenagers and adults), which has increased interest in museums.[33] Different levels of detail and presentation of a lay material can be worthwhile.

Specialised education on lay communication for scientists

The importance of specialised training for writing for lay audiences has been recognised by Cancer Help UK[34] and the CDC.[32] They understand that researchers find it hard to write for lay audiences, so they have provided their team with training. Also, PLOS has a team of editors and writers that write lay summaries for peer-reviewed articles.[34]

A: About the research

(i) What is the research about?

(ii) How will the research have an impact on stroke survivors?

(iii) How does the research build on research that has already been done?

B: About the researchers

(i) What is the applicants' experience in stroke research?

C: How will the research be carried out?

(i) What does the research involve for people taking part? Are there any risks?

(ii) What information will you collect, and how will you use it?

(iii) Will people have to travel to take part? Will you pay their expenses?

(iv) How will you make sure no-one is out of pocket by participating?

(v) How will you keep the people that took part informed about progress and results?

D: What happens when the project is finished?

(i) What will you do with the information you collected from people who took part?

Figure 2: Questions to guide writing a lay summary required for grant applications. Source: Stroke Association (https://www.stroke.org.uk/research/looking-funding/apply-project-grant). Reprinted with permission.

After all, lay communication is not just taking out jargon and replacing it with more understandable text but rather a complete 'repackaging' of the scientific message.[35]

Brownell *et al.* plead for including a lay writing course in the curricula of undergraduate and graduate science programs.[8] Scientists should be trained early enough not only in how to communicate with lay audiences but also about the importance of the associated values, namely, that informing the public is a duty and not a time-consuming downgrading of scientific work.

Scientists should be made aware that communicating scientific work directly to the public is a positive step towards eliminating the impact of misinterpretation or misrepresentation by the press.[23] They should also be informed that lay communication is rewarding and academically productive because it is the best way to gain public support.[7] Through time and re-education of the new generation of scientists, the needed cultural change will take place.

Journals and publishers

Journals and publishers should require lay versions of publications[23]. This will strengthen the scientist's effort to communicate their science to lay audiences. The editor-in-chief of *Ecology* agrees but is worried that an ineffective lay version will only be ridiculed by scientists.[2] A truly good lay version should still communicate the relevance of the research, but this may require additional writing support and

A

Background

Patients retained in HIV care but not on antiretroviral therapy (ART) represent an important part of the HIV care cascade in the United States. Even in an era of more tolerable and efficacious ART, decision making in regards to ART offer and uptake remains complex and calls for exploration of both patient and provider perspectives. We sought to understand reasons for lack of ART usage in patients meeting the Health Resources Services Administration definition of retention as well as what motivated HIV primary care appointment attendance in the absence of ART.

B

Background

AIDS has killed about 39 million people since the first recorded case of the disease in 1981, and about 35 million people are currently infected with HIV, the virus that causes AIDS. HIV, which is usually transmitted through unprotected sex with an infected partner, destroys CD4 lymphocytes and other immune system cells, leaving infected individuals susceptible to other serious infections and to unusual cancers. Early in the epidemic, most HIV-positive individuals died from an AIDS-defining illness such as recurrent pneumonia, severe fungal infection, or Kaposi's sarcoma (a type of cancer). Nowadays, although there is still no cure for AIDS, treatment with antiretroviral drugs (antiretroviral therapy or ART) can hold HIV in check, and, at least in affluent countries, HIV-positive individuals who are on ART now have a near-normal life expectancy.

Why Was This Study Done?

HIV-positive individuals originally only started ART when their CD4 cell count fell below 200 cells/mm3 blood. As ART became more tolerable and more efficacious and as the harmful effects of viremia (HIV in the blood) became clear, the treatment threshold shifted upwards. Nowadays, the US ART guidelines, for example, recommend treatment for all HIV-infected individuals irrespective of cell count and, because ART reduces the risk of an HIV-infected individual transmitting the virus to an uninfected sexual partner, also endorse offering ART for the prevention of HIV transmission. However, 40,000 HIV-positive individuals in the US receive regular HIV care such as virus monitoring but are not prescribed ART, and 5% of individuals starting ART discontinue treatment. It is important to understand why HIV-positive individuals do not use ART, but decision making in relation to ART is complex, involving both the HIV-positive individual and their HIV care provider. HIV-positive individuals may refuse ART if they think their care provider does not believe they really need treatment, for example, and providers may not offer ART to someone they think will not adhere to treatment. Here, the researchers undertake a qualitative patient-provider dyadic study (an analysis of contrasts and overlaps between pairs of narratives) to investigate why some HIV-positive individuals are retained in HIV care but are not on ART and what motivates these individuals to attend HIV care clinics.

Figure 3: Example of a lay summary based on a publication in a peer-reviewed journal. (A) Background part of the abstract provided by the author(s). (B) Corresponding parts of the non-technical lay version as written by an experienced editor. Source: Christopoulos *et al.* PLOS Med. 2015 Aug 11;12(8):e1001863. Reprinted under Creative Commons open access.

therefore cost. An example of a non-technical version of the background part of an abstract is shown in Figure 3. To support the usefulness of lay summaries, cost-benefit assessment and, therefore, additional evidence about the public's attitude towards lay information is needed.[36]

Conclusion

The path towards lay communication will not be simple, but if scientists are willing to learn how to balance accuracy and accessibility,[23] they can overcome the pitfalls. Not all scientists are gifted writers, but because they are trained to think clearly, they should be able to write clearly and share their enthusiasm with not only their peers but also with the public.[11] Cooperation between scientists and organisations can truly strengthen the commitment to engage the public and to make scientific information accessible .

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