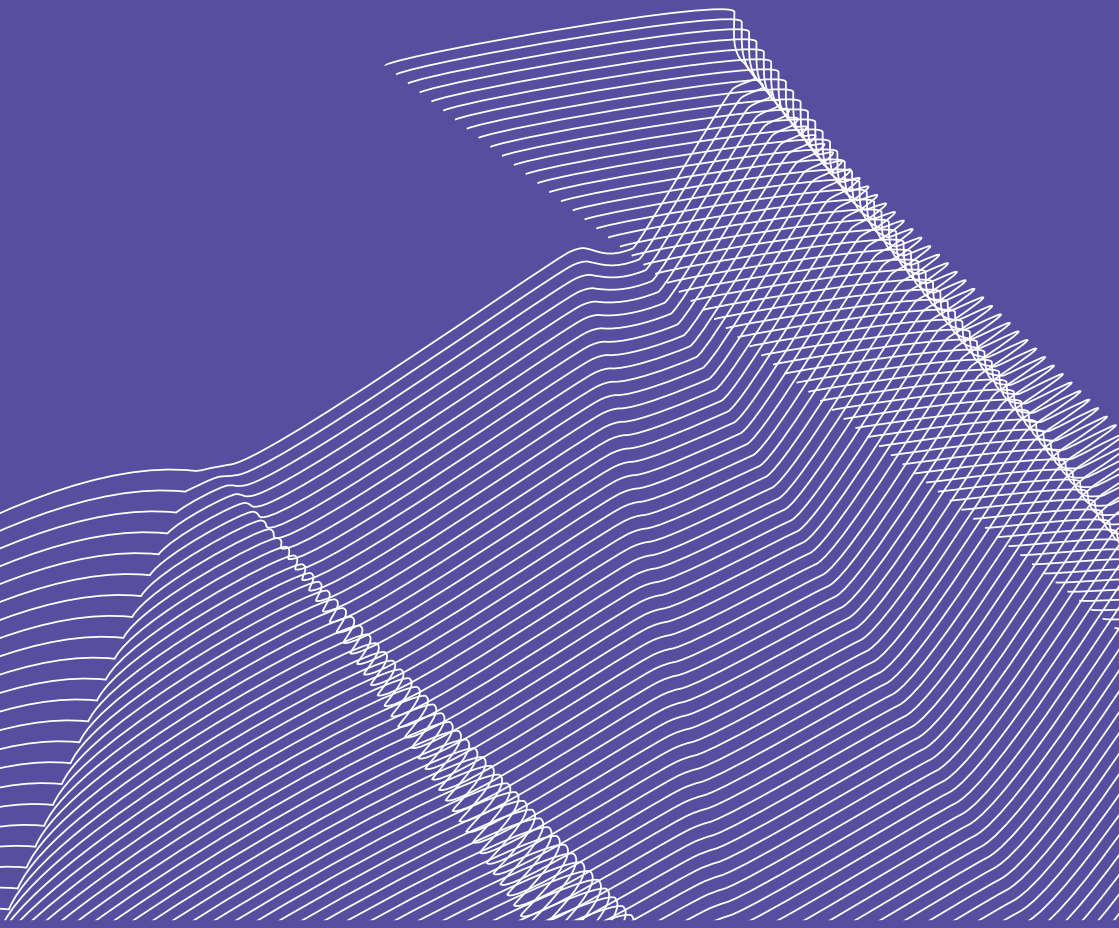
Die Junge Akademie

A Guide to Science Communication

A contribution to the debate by Viola Priesemann, Charlotte Bartels, Johanna Gereke, Fabian Hruschka, Birgit Nemec, Doris Segets and Leonie Wenz



A contribution to the debate by the Wissen kommunizieren project group

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This series publishes ideas and positions from members of *Die Junge Akademie*. This publication was created within the "Science communication" project group. It reflects the views of the named authors but does not necessarily represent the views of the entire project group or the entire *Die Junge Akademie*.

Contribution to debate

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Introduction

Whether it's climate change, technological innovations, pandemics, or social inequality – science communication is essential for a well-informed public debate. However, communicating knowledge that is simply exciting or interesting for society is also an important part of science communication. As scientists, however, we are primarily specialised in research and communicate our results mainly within the specialist community. In order to share our knowledge effectively with the public, we need to communicate in a different way. Be it when creating our own articles for traditional and new media and platforms, in interviews and discussions with journalists, or in policy advice.

As long as you are not under time pressure, you can gradually gain experience through workshops on science communication and by writing smaller articles. Sometimes, however, especially in times of crisis, your own expertise is requested very suddenly and urgently, so that there is hardly any time to familiarise yourself with science communication. Regardless of whether you want to get started slowly or your expertise is suddenly needed, whether you just want to follow the debate or actively help shape it – with this guide, we would like to offer you some orientation so that you can better use, understand, and reflect on the written and unwritten rules of science communication.

Die Junge Akademie is the young academy of the German National Academy of Sciences Leopoldina and Berlin-Brandenburg Academy of Sciences and Humanities.[1] As a team of *Die Junge Akademie*, we have conducted numerous structured interviews with experts from science, politics, and journalism to provide you with comprehensive orientation and practical tips for successful science communication. In addition, this guide is also based on a wide range of literature, which you can find in the appendix. Overall, we have identified five key points that should define the form and limits of communication. In addition, we have compiled specific tips and a checklist. You will also find background information on communication channels, rules, and practices for dealing with media enquiries and approaches for dealing with errors, attacks, or disinformation. Finally, we present a vision of science communication: we can only achieve our goals if we formulate them.

1 You are reading a translation of the original publication: Priesemann, V., Bartels, C., Gereke, J., Hruschka, F., Nemec, B., Segets, D., & Wenz, L. (2024). *Wissen kommunizieren: Leitpunkte aus der Jungen Akademie.* Die Junge Akademie. The original publication is available for download at the following link: https://doi.org/10.5281/zenodo.14879968.

Some disclaimers in advance: It goes without saying that we cannot cover the topic of science communication in its entirety, depth, and breadth. Our guide, therefore, does not explicitly claim to be a comprehensive scientific analysis. We also focus on interaction with traditional media and professional journalists. However, we believe that the same principles apply to new platforms that offer even more diverse opportunities for communication and discourse. Furthermore, many of our examples focus on the empirical sciences, for example, in the classification of data collection or the recording of statistical uncertainty. Again, the basic principles are equally applicable to many other disciplines. So, choose the right one for you from the wide range of topics, whether for initial orientation or to reflect on the public debate. Last, but not least, please note that this guide is written from the perspective of German science communication. While most principles apply internationally, note that some aspects may be specifically German.

Despite – or perhaps because of – the numerous challenges in science communication, we hope you enjoy reading this guide and wish you every success with your science communication!

Your “Science Communication” team at *Die Junge Akademie*

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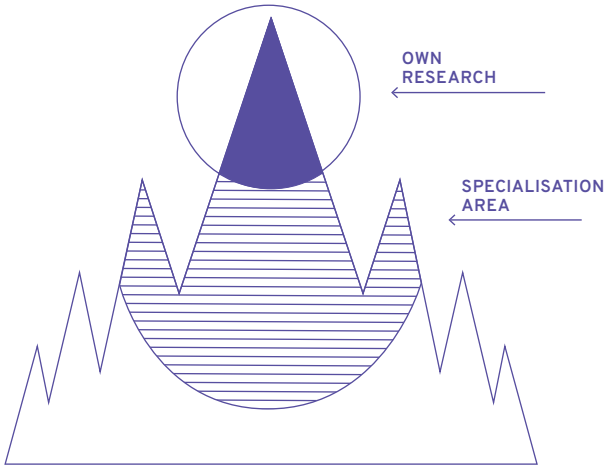
Contents

Five key points of science communication

Would you like to get involved in the field of science communication, or have you unexpectedly received a request, perhaps even in the context of a heated public debate? Or have you already gained a lot of experience but still face limits or encounter conflicts whose dynamics are unclear?

Our guide is designed to help you get a better overview: What exactly do you want to convey? How can you pass on your knowledge effectively, and on which topics do you not want to take part in the public debate? How do you separate knowledge from judgement? Would you rather stay in the area of knowledge transfer or enter the debate on values? How do you deal with uncertainties and simplifications – without inadvertently misrepresenting something? And what motivates you to engage in science communication?

With the following five key points (German: “Leitpunkte” (LP) – guiding principles for orientation), we aim to help you reflect on the dynamics of public debates and effectively shape your science communication according to your own needs and goals.



LP1: Communicate only about your own area of expertise

If you are actively researching a topic, you are very familiar with the state of knowledge and the controversies concerning it. If you comment on issues outside your own area of expertise, there is a greater risk of communicating misleadingly or even incorrectly. This can lead to an inaccurate representation of the state of knowledge in the media or fuel unnecessary controversy. You should therefore know the limits of your own expertise and respect them in your communication. Where exactly these limits lie can depend on many individual factors.

Even if these boundaries are not always clear, it can help to consciously ask yourself: On which topics and areas do I want to communicate? What do I not want to comment on? You can reflect on this distinction along the following points, for example:

1. Your own research covers topics that you are currently working on. Therefore, you are typically up to date on research questions, but also on controversies and possible limitations.

2. Your specialisation area includes the topics you study and the current research you follow closely at scientific conferences and in the literature.

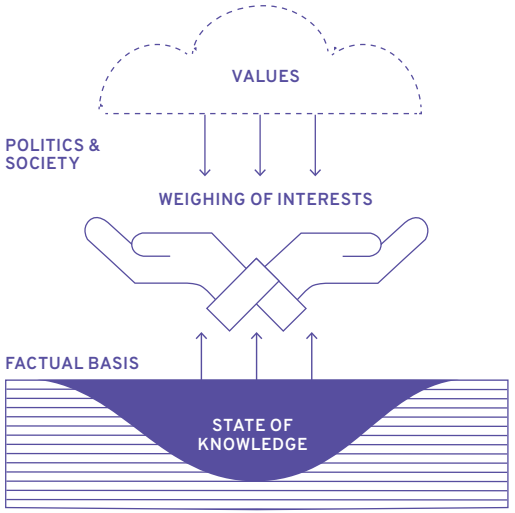
3. The neighbouring fields comprise the areas that you are familiar with because you have researched or taught them in the past, but in which you have significantly less detailed knowledge than in your own area of specialisation.

Knowledge of one's own research is the ideal basis for science communication. If you express yourself more broadly in your own field or on topics from neighbouring fields, misunderstandings or even mistakes can arise more easily, as you do not have a complete overview of the current state of research or are not up to date in certain debates. Here, you can decide to provide journalists with background information and refer them to colleagues for more in-depth information in order to communicate optimally as a scientific community[2].

In our experience, it can help to compile a positive list of topics and results that you want to comment on. This allows you to define your own communication boundaries. These limits can then be defended more easily if, for example, journalists ask questions that go far beyond their own expertise or include suggestive questions. Of course, the exact limits of one's own expertise also depend on one's own experience and accumulated expertise and should be individually defined and continuously updated.

We are aware that the proposal to maintain the boundaries of one's own expertise is a complex task and that the boundaries are often of a gradual nature. Furthermore, drawing these boundaries may be somewhat easier in the natural sciences than in other disciplines. Nevertheless, we believe it is crucial to reflect on the boundaries of one's expertise and to communicate these clearly to the outside world. Of course, as a scientist, you know more about many topics than laypersons, but you are almost certainly less knowledgeable than many other colleagues and experts. Being aware of your own limitations can help to reduce misunderstandings.

2 For example, you can say, "This is not the core of my expertise." "My understanding of the topic is as follows." "And you can contact the following people for more in-depth information." You can also make it clear which information should only be used as background information because it does not reflect your core expertise, and which information is intended for the public.



LP2: Clear demarcation of factual basis, state of knowledge and evaluation

Science[3] aims to be as value-free as possible; however, depending on the discipline, the research question may already contain value judgements and assumptions. A clear distinction between factual basis, state of knowledge, and evaluation is therefore helpful in public discussion. While this demarcation is quite simple for some topics, it undoubtedly poses an immense challenge in other areas[4]. Nevertheless, we believe that the underlying facts, definitions of terms, and assumptions about the state of knowledge should be made as transparent as possible to enable a productive discourse on balancing interests. We therefore see the following levels:

1 Most fundamentally, we assume that there is a "true" state or measurement, whether we can measure it or not – be it the mass of an electron or the level of poverty on a given day. This is what we call here the factual basis. Simply said, it

3 "Science" and "journalism" are, of course, very heterogeneous. Nevertheless, we use the terms in the singular, as the two groups are relatively clearly distinguishable from each other, and terms such as "scientists," etc., can be replaced by a single term in this way.

4 Examples: The energy loss when converting electricity into a form of e-fuel can be calculated; whether the investment is worthwhile also depends on society's goals and values. In the case of issues such as child poverty or the distribution of care work, society's goals and values also determine how this should be assessed and possibly changed. In order to measure them, however, these variables must first be defined and operationalised.

is what is. Some things can be defined and measured very clearly and precisely, such as the mass of an electron. For other areas, such as poverty, an operationalisable definition[5] must first be found and assumptions made. This also makes it possible to record or measure these things, which then provides a basis for further discussions.

2 Science determines the state of knowledge and the corresponding uncertainties based on the state of research. For the public debate, the state of knowledge often must be synthesised from many different specialist areas. Of course, the state of knowledge can change when new findings emerge. It is also important to reflect the breadth of the various theories and approaches as well as possible.

3 Based on this, a well-informed social and political weighing of interests can take place. This is a continuous process but should always be based on the current state of knowledge in order to avoid unrealistic proposals. Sociopolitical goals and values play a decisive role in this process.

In our experience, it is a sensible communication strategy to first address the factual basis and the knowledge that has already been acquired. Controversies often arise because different groups make different assumptions about the state of knowledge. If the state of knowledge were to be ignored, individual specialist areas are ignored; if an incorrect or outdated state of knowledge were to be assumed, the conclusions may become arbitrary (*ex falso quodlibet* – from the wrong follows the arbitrary). For this reason, it often makes sense to first establish the common discourse framework and state of knowledge. Building on this, society and policymakers can then weigh up the interests at stake when conflicting interests, objectives, and associated costs need to be considered. In order to build a bridge between the state of knowledge and the weighing of interests and to facilitate the aggregation of different expert opinions, clear, alternative scenarios can be developed across disciplines (for example: If measure A or B were to be taken, then we can expect the following costs, effects, and developments).

Scientific statements should be verifiable with corresponding scientific sources, ideally in the form of a bibliography. Even if no or only a few sources are often referenced in practice, boundary conditions and assumptions about the factual basis should be made transparent. If the assumptions already contain value judgements, this should

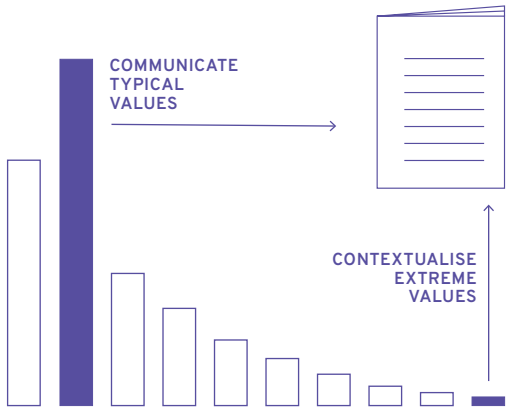
5 These definitions are not always unambiguous. However, it is important that they are comprehensible and well-founded. This allows them to be communicated clearly so that everyone is talking about the same entity.

be pointed out explicitly. Referring to the state of knowledge, and in particular, to specific scientific research results – including those of colleagues – clarifies in a comprehensible way how scientific findings are established.

Many scientists are willing to talk about their knowledge. However, when asked about their evaluation, many are reluctant for good reasons. A poverty researcher can, for example, report on the scientifically measured extent of poverty and explain the assumptions underlying the measurement and the development over time (poverty measured in this way is increasing or decreasing). However, the question of whether poverty is too *high* is ultimately a political issue to be weighed up by society.

The ideal of science, even if it is difficult to achieve, is to present the state of knowledge as objectively and value-free as possible. If, for example, you were asked or pressured to give a personal evaluation or opinion, you are free to refuse as a scientist. Instead, you can talk about different scenarios, their plausibility, and possible consequences.

If you decide to express your evaluation or opinion or to act publicly in favour of one option or choice, we believe it is helpful to clearly distinguish personal contributions and preferences from scientific expertise, pointing out personal assessments (using phrases such as “I as a citizen think/my/find xy”). However, it is important to be aware that you are always speaking with the authority of science, even if you do not intend to do so.



LP3: Communicate uncertainties and avoid exaggeration

Trust in science requires transparent and clear communication about established knowledge, but also about the limits of this knowledge. This concerns reliability (reliability of data) as well as validity (reliability of assumptions). In our view, the imprecise use of extremes (e.g., a quantitative "up to a fantasy billion in additional costs" or a qualitative "ground-breaking therapy") should be avoided, as it represents imprecise science communication and, in extreme cases, can fuel a polarisation of the public debate.

Long-term trust in science requires open and careful communication about the limits of knowledge. This also includes naming uncertainties and dealing transparently with extreme values: if extreme scenarios are expressed, they can be classified by clearly labelling them and communicating the probability of occurrence of these extremes.

The core problem with extreme scenarios is that they can usually be arbitrary; it should therefore be made clear how likely or plausible an extreme scenario is. Does it have a probability of occurrence of 10 per cent, 1 per cent, 0.1 per cent, or some other arbitrarily small plausibility? What individuals consider to be an extreme scenario, or a realistic scenario can certainly vary. In order to not forget the probable scenarios, they can be communicated first before naming the extreme scenarios (in both directions, optimistic and pessimistic). It should be made clear how "extreme" or unlikely these scenarios or forecasts are. This makes science communication more complicated, but in the long term, it can be beneficial to help society accept this complexity and build and maintain trust in science.

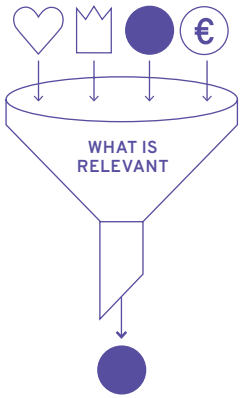
The scientific statements should always be discussed together with all uncertainties, i.e., the uncertainties that arise from the data (reliability), as well as assumptions and possible systematic errors that arise because certain factors are not known, or their existence or influence was not or could not be taken into account (the "unknown unknowns"/validity).

Examples can illustrate an issue well. However, if you contribute anecdotes or experience reports from your own environment, it is important to identify them as such and to classify them against the background of the state of knowledge[6].

The search for attention – not only on social media – can lead to exaggerating the progress of one's own work or to it being exaggerated by others. In the medium term, this can deceive expectations if, for example, the "breakthrough therapy" is only a clinical phase I study, and it may be years before a drug comes onto the market – if at all. There is a desire or need for escalation, sensation, and attention from many sides. You should therefore stick to a realistic assessment of the "sensationalism" of your (own) research and defend it in your interactions with journalists in order to avoid exaggeration.

Even if the discussion about discrepancies, gaps in knowledge, and uncertainties needs a lot of attention, we should not forget that there is very precise knowledge and very strong evidence in many areas: We know the mass of electrons, for example, to more than nine decimal places, and there is also a broad consensus that the Earth is more like a sphere than a disc. However, little is said about this undisputed part of the state of knowledge. Focusing the discussion on the controversies can give the impression that science is not in agreement. The intensive discussions take place much more at the boundaries of established knowledge. The areas of knowledge in which there is strong evidence should therefore also be communicated along with the uncertainties and new findings.

6 Example from the context of the vaccination debate: Let's assume that an infection with an *imaginary* virus has a 1 per cent probability of being fatal, a vaccination reduces mortality to almost zero, but 1 per cent of people get vaccination side effects: In your own environment, if many people get vaccinated, you will hear about vaccination side effects but never actually witness any deaths. To conclude from this that you should not get vaccinated because there are quite a lot of cases with vaccination side effects but no deaths in your own environment is consistent with private observation, but it is a wrong conclusion because it ignores all the avoided deaths (provided you value death as a more negative outcome than the specific side effects). Systematic clinical trials exist to avoid such errors. This example is a classic case of the prevention dilemma.



LP4: Illuminating the motivation for communication

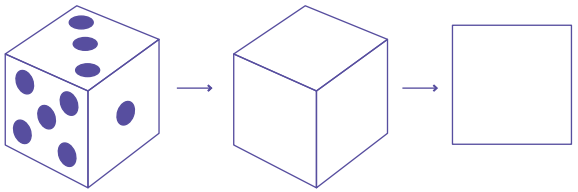
"What is my motivation for communicating?" should be one of the initial questions when deciding whether to speak on a topic. "Do I have something professional to say on this topic?" could be another fundamental question. Communicating with the aim of increasing your own visibility or representing interests can be at odds with well-founded and fact-orientated science communication.

The strength of science communication is the factual communication of new and/or important aspects and findings. However, the boundaries to judgement and activism are not always clear. Especially in communication contributions to socio-political discussions, disclosing potential conflicts of interest should be a matter of course. What is my own motivation for communicating? Do I have new data or findings for the social or scientific debate, or am I communicating basic research? To what extent am I politically motivated? Do I want to exert influence myself or become visible and famous? Are there financial incentives in the context of research? Is there payment from the media? Which stakeholders and representatives of interests influence the debate, and what interests does the journalist pursue? Since these questions are difficult to answer from an internal perspective, it can be useful to ask colleagues for an assessment.

Journalists can also have different motivations. Occasionally, there is an interest in using scientists as protagonists for media coverage, controversy, and outreach. Such controversies can fuel a false balance[7]. Requests in which you are only supposed to serve as a protagonist in a prefabricated story or to merely stage a controversy may be rejected. One approach can be to record a lot of interview material and only use a few half sentences, in extreme cases without the correct context. In live formats, on the other hand, it is clear that everything that is recorded is also broadcast. We want to emphasise that in the vast majority of cases, however, there is a genuine interest in the content.

Good science communication takes time and requires a lot of practice and experience. This is precisely why there are courses and degree programs for this. For scientists, active communication reduces the time they can spend on their actual core expertise, research, and specialist teaching. You should therefore think carefully about how much you want to and can get involved. Perhaps more specialised experts at the interface between science and science journalism could build a bridge here. No scientist should be obliged to engage in science communication.

7 False balance, also known colloquially as bothsideism, refers to the false balance of a media debate. In this process, clear scientific minority opinions are presented in the media in such a way that they appear to be of equal value to the scientific consensus. This creates a distorted public perception of the state of scientific knowledge. For more information on the challenges of dealing with false balance, see Part III – Utopia.



LP5: Up to the limit of simplification – and not beyond

The state of knowledge must always be presented correctly. However, just like research itself, understandable communication requires simplification. One must be aware of the limits of this simplification and should express this clearly in scientific communication.

Great simplification is often necessary in order to communicate a topic in a way that the general public can understand. This can be done, for example, through a comparison or through images and metaphors. Simplifications in themselves are also usually necessary in science: A theory or model is per se a simplification of the object of research. The central question is whether the corresponding simplification is helpful in answering a specific question[8].

Anyone using simplifications, comparisons, or images as rhetorical devices should bear the following aspects in mind: The level of knowledge must always be presented correctly, and you must be aware of the limits of simplification and state these explicitly. It should also be emphasised that a comparison is helpful for certain aspects but can be misleading for others. Oversimplification can lead to polarisation or misunderstandings[9]. If simplifications were used, they should be clearly marked as such, for example, with sentences such as "I am illustrating this with a very simplified comparison." We believe that we build trust in the long term if we trust and expect society to accept the necessary complexity.

8 "All models are approximations. Assumptions, whether implied or clearly stated, are never exactly true. All models are wrong, but some models are useful. So the question you need to ask is not 'Is the model true?' (it never is), but 'Is the model good enough for this particular application?" - Box, Luceño, Paniagua-Quiñones, del Carmen (2009), *Statistical Control By Monitoring and Adjustment.*

9 Example: The statement "The vaccination protects against infection" clearly generates effects that differ from the statement "The vaccination protects quite well against infection."

Practical information on communicating with the media

If you are just starting out in science communication, there are many questions: How do you make contacts? How do you prepare properly? What do you need to bear in mind when it comes to confidentiality and citations? And how do you deal with mistakes?

In this guide, we focus mainly on traditional contact with journalism. However, the new media make it much easier to get into communication, offer a direct line to the public, and provide complete control over your own content. We only cover this in passing here, even though we see great opportunities there, but of course also new challenges. In the following, we will go through the relevant topics chronologically and compile a detailed checklist.

1. Prepare and establish contact

How can you prepare for an interview?

When preparing for an interview, professional expertise is, of course, essential. At the same time, you need to be familiar with the current debates in your field, in society, and in politics. You should also be able to express yourself clearly and define your own communication goals before the interview. Our expert interviews revealed some practical tips and hints. These are listed in chronological order along the communication process in the "Science Communication Checklist" below. In a live interview or panel discussion, you usually only have a few minutes to speak. It is important to use this time as efficiently as possible to get the most important points across clearly. In both short and long formats, you should therefore be clear in advance about which points you can and want to make and which not.

Before accepting the request:

- ☐ Ask the subject area question (LP 1) and relevance question (LP 4) – if in doubt, forward to colleagues or cancel; likewise, if the topic or request does not suit you
- ☐ Respond promptly: Journalists often have to work under time pressure
- ☐ Ask about the thrust and aim of the interview or format
- ☐ Involve your own employer's press office: They should at least be in the loop but can also provide concrete help
- ☐ Possibly clarify interviews with the management of your own scientific institution

- ☐ Address authorisation of quotations
- ☐ Possibly ask for a preliminary talk
- ☐ Ask for which department and medium the publication is planned for (science journalists are sometimes deeper into the topic than colleagues from other departments)
- ☐ Point out any existing conflicts of interest
- ☐ Prepare conceptually (see below), identify topic, focus on 3-5 key points and formulate the 3-5 points as core statements
- ☐ Think about possible headlines: many articles need them, and you may have a strong term or statement that is suitable in principle, or aspects that are not. The decision about headlines, however, is the sole responsibility of the editorial team
- ☐ Clarify embargo[10]

During the interview:

- ☐ Clarify the level of confidentiality (see Part 2)
- ☐ Dare to say “no”: Point out the limits of one's own expertise or refer to other experts (LP 1)
- ☐ Distinguish between scientific evaluation and personal opinion (LP 2)
- ☐ Have the courage to say “no” if you are pressured to make assessments that you cannot or do not want to make, point out suggestive questions and do not answer them, or ideally use elegant strategies for turning away (LP 1 and 2)
- ☐ Communicate uncertainties and avoid exaggeration (LP 3)
- ☐ Pay attention to comprehensibility but do not oversimplify (LP 5)
- ☐ Keep the focus on the 3-5 prepared core topics during the (live) interview so that there is time for these and you do not talk about other topics that you did not want to discuss
- ☐ If necessary, bring in a person from the press office or a colleague to assist with the interview

After the interview:

- ☐ Obtain feedback from colleagues or the press office
- ☐ Authorise citations carefully and promptly, also with regard to possible misunderstandings
- ☐ Ask to speak to the contact person if anything is unclear
- ☐ When mistakes happen, deal with them constructively and get support (see Part 3: Correction ex post)

10 Embargo rules are often used by scientific journals. The publication may not be communicated publicly before the embargo period expires. This must be observed.

- ☐ Do not underestimate the psychological consequences of attacks or mistakes and seek help early on
- ☐ In the event of personal attacks: get help, e.g., at home or via the scicomm support hotline (+49 157 923 448 04, daily 7–22 h, MEZ)[11]
- ☐ Celebrate the successful contribution and make it visible: link to the official and own website together with the press office, share on social media, list in the institute's newsletter, etc.
- ☐ And finally, don't forget: Science communication has its challenges, but it can also be a lot of fun!

Channels of communication

Press releases

The exchange between science and traditional media can be initiated from both sides: As a scientist, you contact the media if, for example, there is an important new research result of your own that has already gone through peer review but has not yet been published (embargo period), or if you have something important to contribute to a current debate. In these cases, the press office can help with the preparation and distribution of a press release. Alternatively, you can write to editorial offices and ask whether they are interested in the topic. Contacting the regional media (local press, city radio) can also be a good start to communication. Editors also monitor posts on social media and then write to the authors directly. If it is about your own publication, which is published in a trade journal, embargo rules must be observed. Assistance from the press office and specific coaching and tips from colleagues can be very helpful throughout the entire communication process.

When writing a press release, you should not only refer to your own work, but also to the research of colleagues. Press releases are, in the worst case, somewhat one-sidedly focused on your own topic and may exaggerate your own impact. At best, they categorise the topic realistically and broadly. Press releases should not become advertising texts but should communicate knowledge broadly[12].

Media inquiries

If journalists approach you via the press office or directly, it is important to check whether the media inquiry meets the requirements of the key points. If you receive a

11 The hotline primarily operates in German, but it is highly likely that the scientists managing the hotline also speak English.

12 See guidelines for good science PR in the appendix.

media inquiry for the first time, support from the press office, experienced colleagues, or coaches can be very helpful. However, time pressure can quickly kick in if the press wants an answer within hours. If you have not yet prepared anything on the topic or do not have any in-depth expertise, you may not be able to respond to the request adequately. Here, it should clearly apply: Quality before speed.

New media

Beyond the traditional media, the so-called new media have opened up completely new possibilities for science communication: Scientists can communicate directly with the public. However, this communication may also be very challenging. All communicators on these channels are confronted equally with shorter attention spans and increasing competition. The risk of becoming the target of hate speech or excessive, unobjective criticism is also very high due to the highly responsive nature of new media. You should, therefore, think carefully beforehand about where, how, and what you communicate via these platforms. The possibility of reaching large parts of the younger target groups and having a very low threshold for starting communication is nevertheless an advantage. This guideline deals primarily with traditional media. However, many principles can be easily transferred.

How can you prepare yourself conceptually?

Preparing your own science communication conceptually can be particularly helpful for talk show appearances, live interviews, or radio broadcasts. Due to the direct broadcast format, it is often not easy to correct statements and only possible to contextualise them afterwards to a limited extent. In addition, the time available is short. It is therefore necessary to focus on the most important points. It is, thus, advisable to identify and pre-formulate 3-5 key points in advance that you would like to address in any case. In the interview itself, care should be taken to concentrate on these points. For points that have not been prepared, you should generally exercise restraint, as spontaneous, possibly clumsy formulations can lead to misunderstandings. You will also have less time to get the key points across.

Time pressure: The time scales of journalism and science are different

There is often time pressure in journalistic research. Once more: Under no circumstances should time pressure compromise the quality of communication. It happens that the self-confident, fast experts answer first and thus gain more visibility in the public discussion. Both sides, science and journalism, could ensure that the slower, more considered voices are also given a fair hearing (see Utopia).

If you want to be present for science communication in a timely manner, it can be useful to pass on your cell phone number to journalists. If the debate on a topic is intense, you may be asked a lot, and science communication can become very time-consuming. In order to be available for communication on the one hand and not have to say the same thing over and over again on the other, there are intermediaries such as the Science Media Center (SMC), which bundle expert knowledge and disseminate it widely. The SMC contacts the scientists registered with it[13] with a request for a written statement on specific questions and passes this information on to journalists. The SMC also organises press conferences where journalists can ask the invited scientists questions. In this way, a significant reach can be achieved with a little less time. The problem of too many enquiries is probably the exception for scientists, but it is precisely in these phases that the burden can be immense, as it is usually a novel situation, the research has to be managed in parallel, and there is a desire from society for the fastest possible answers. Especially in such phases, intermediaries can simplify science communication and efficiently contribute to giving diverse voices their place.

How can I understand the objectives of the media enquiries?

It is helpful to know that there are very different types of media enquiries. In the best-case scenario, research on an important topic is open-ended and in-depth, and there are detailed preliminary discussions whenever appropriate and necessary. However, there are also cases in which the script has already been written, and only a professor or person with other academic authority is being sought who represents a certain statement. It is also possible that you are then strongly pushed into a role, or a quote is selectively taken from the wealth of statements included. In case of doubt, you can refuse, even if you would have liked to contribute. However, this problem is not the norm, but you should be aware that it does exist.

In other, less extreme cases, it is difficult to deal with the questions because they do not relate to one's own specialist expertise (LP1), they ask for opinions rather than knowledge (LP2), or the questions simplify the facts very much (LP5) or present them in an exaggerated or suggestive way (LP3). This is where young researchers should consider whether they want to take some of their valuable time for this. In order to better assess the intention of an inquiry, it helps to ask which department the inquiry comes from and what the thrust or topic area will be. Occasionally, journalists may provide pre-formulated questions either to prepare for an interview or as a substitute for conducting one. This can help to better categorise the inquiry and write targeted answers. At the same time, researchers should not feel limited to these questions, especially if they do not cover important aspects.

13 There is the option of registering with the Science Media Center as a scientist with a subject area, area of expertise, and current research projects.

2. Communication with journalists

The three levels of confidentiality

In order to clearly define the usability of the contents of interviews between scientists and journalists, there are the so-called three levels of confidentiality. These regulate the handling of the information received and create a protected space in which scientists can express themselves more freely in background interviews without what is said being made public directly and before it has been possible to check its professional accuracy again. This concept originally comes from politics.

The applicable level of confidentiality is best defined at the beginning of the conversation. It can be changed explicitly during the conversation. The levels are as follows:

- **Under 1:** The discussion is public; quotes from it may be used directly or indirectly with name and institution. You can ask for authorisation of the quotes; this is particularly common in German-speaking countries.

- **Under 2:** The information received may be used and quoted anonymously. This results in formulations such as “According to party circles: …”. This is rather unusual in science.

- **Under 3:** What is said is confidential. Knowledge gained may only be used as an incentive for further research or as background information. It is not permitted to quote the content of the conversation, whether directly or indirectly.

If the level of confidentiality is not defined independently, conversations are usually treated as “under 1,” and the information is considered to be freely available. However, it is usually also possible to mark what has already been said as confidential afterwards.

Confidentiality in a background discussion can be chosen for many reasons: If you are talking about neighbouring fields in which you have good but not complete expertise, you can add this information as background or context to your own core expertise. However, there are also situations in which possible conflicts of interest or the avoidance of attacks on one's own person are involved (e.g., in politically or socially very controversial topics). Overall, the scientific community wants to ensure full transparency in communication. Invoking the levels of confidentiality should therefore only be done in exceptional cases or if the statements are outside of your own expertise. In this case, you should refer to colleagues whose core expertise covers the topic.

Contribute to being accurately portrayed in the media

In interviews with print and online media, it is common practice in Germany to ask for authorisation of verbatim quotes in order to prevent misunderstandings and false statements. Typically, inaccuracies or errors that have arisen in the interview or during the text work can then be corrected. It can help to emphasise that this is not about limiting the independence of journalism but about preventing misunderstandings and avoiding erroneous statements. Journalists often work under time pressure, and it takes time to get quotes authorised, so it makes sense to agree on the time frame in advance. With mutual respect and open communication, successful authorisation is possible in most cases. At their core, science and journalism have the same goal: a deep understanding of their topic.

The authorisation of quotations is primarily practiced in German journalism and less frequently in Anglo-American countries, for example. Even if it is not obligatory in Germany, it is common practice.

Tips for dealing with citations submitted for authorisation:

- Quotations do not necessarily have to be verbatim but only correct in terms of content.

- The authorisation process often takes place under enormous time pressure. You should therefore be prepared to authorise quotes within a few hours. It is a good idea to ask the journalist for a rough time frame for approving quotes during the interview so that you can plan accordingly.

- As a rule, quotations are sent with a preceding and following text context. It is important to note that the editors retain control over the text. Only if something is really wrong or completely distorted should it be noted or corrected.

- If the entire text is available for authorisation, which is not usual and indicates a high level of trust on the part of journalists, then it is important to refer only to the points of your own expertise and presentation. Again, you should only comment on something if it is really wrong or distorted.

- Authorised quotations are considered to be correct in terms of content, i.e., an authorisation confirms the correctness of the quotation. Here it is important to avoid blurring or inaccuracies, which are often caused by simplification or dramatisation by the editors.

- The title and teaser of the text are usually not set by the authors but by the editors; the context thus created is therefore beyond their control. Parts of verbatim quotes can certainly be used as (inter-)headlines or taken up by other media, even if they may seem somewhat out of context. When authorising verbatim quotations, this particularity should be kept in mind.

- The press office can help with the authorisation of the quotes provided.

Avoiding mistakes in communication

Anyone who communicates science to the public over a long period of time will sooner or later make mistakes. It is therefore important to consciously address the issue of good science communication. A lot has already been done by observing the key points outlined in the first section as well as good conceptual preparation. Furthermore, it is perfectly okay – even very important – to say "no" sometimes in interviews, i.e., not to answer questions that you do not feel comfortable with or to repeat pre-formulated, negative phrases. This may be particularly difficult in certain situations; in which case it can be helpful to conduct the interview together with the university or institute press department or a colleague who can slow you down in case of doubt. It is important to remain calm if you are attacked. It can be beneficial to respond with humour or a counter-question. Humour can defuse a difficult situation. In the best-case scenario, this is followed by a factual, clear answer. It can also help to differentiate between *ad personam/ad hominem* attacks ("You've been bought"), factual attacks, and unspecific attacks ("Your statements have always been false"), as defence strategies can differ depending on the type of attack.

3. Correction ex post

What to do if you have misrepresented something yourself?

An ex post correction on a purely factual level is often difficult. False or extremely exaggerated statements spread very quickly in the media landscape, especially if they are spectacular and interesting. The correction, on the other hand, is usually more "boring" and therefore receives less attention. The first step should be to discuss the case with the press office, colleagues, or independent communications professionals. It can also help to write to the journalists or editors afterwards or ask for a phone call in which you address the misrepresentation. Corrections are common in online-only publications – usually accompanied by a so-called transparency notice stating when and where a correction was made.

What should you do if something about yourself is misrepresented?

The same difficulty in fact-based correction applies as described above, as does the advice to seek support and first ask for a personal discussion with the medium. However, there is also the option of taking legal action in the event of serious misrepresentations that could damage your reputation. You can obtain a so-called counterstatement to comment on the misrepresentation and correct it. Under certain conditions, the counterstatement must then be published by the medium that previously disseminated the untrue factual claims.

What to do when experts spread disinformation in their own field?

False statements made by an expert or scientist in their own field pose a variety of challenges for scientists. The first impulse to publicly criticise and refute the statements may be taken up by the media and possibly blown up into a pseudo-scientific dispute[14]. Such a "dispute" has entertainment value for some but does not usually lead to a constructive discussion. It can therefore be helpful to first seek a personal conversation in the background in order to find out whether there has been a misunderstanding or where the discrepancies lie. The person themselves may even have been misrepresented. You can clarify facts publicly without mentioning the person by name. You can

14 For example, the "virologist dispute," which attracted a lot of media attention. For those unfamiliar with the situation in Germany, the "virologist dispute" refers to public disagreements among leading virologists during the COVID-19 pandemic. These debates, often regarding appropriate measures like lockdowns, the contribution of contacts in school to pandemic spread, or mask mandates, sparked widespread media coverage and public discussion – not always with science-based arguments. Similar disputes occurred in many other countries, as experts interpreted evolving data differently, leading to varying recommendations and public confusion.

communicate on a factual level, for example, use formulations such as "There is the following technical statement. I consider this to be implausible or false because ...". Once a false statement is out in the world and is spread even further by media attention, for example, by addressing the "dispute within the scientific community," it is very difficult to dispel it with pure factual knowledge in a way that is effective for the public (see also "Brandolini's law or bullshit asymmetry principle"). When it comes to systematic problems, it is possible to generate enough weight for a topic through communication from specialist societies – for example, via statements – so that the fact-based correction is noticed.

Carrying out scientific controversies in public is not easy. First and foremost, it should go without saying that no pressure or censorship is exerted in any way. The challenge of conducting a scientifically objective discourse in public is, on the one hand, that important aspects are lost because they are oversimplified or exaggerated and, on the other, that the impression is quickly created that science is not in agreement. This is clearly the case at the frontiers of knowledge. But this sometimes means that we lose sight of the core of science: the fact that humans and chimpanzees have common ancestors – even if the details of the family tree are still being researched and discussed – has become a broad scientific consensus and is therefore not the subject of public controversy.

What to do if your own work is criticised?

Scientists are, of course, also criticised or attacked by other professors, rightly or wrongly. If there is reason to criticise the content, it is desirable if the critic first writes to you directly (i.e., not publicly) and, above all, objectively and gives you sufficient time to respond. This allows you to examine the content carefully and calmly and clear up any misunderstandings. A direct public attack is not always conducive to objective discussion.

We know from young female scientists that their public communication was criticised by emeritus professors, among others, who tend to be from outside the field. The critics approached the institute management or ombudsperson[15] with fundamental points such as scientific misconduct. Such suspicions must, of course, be investigated. In the cases known to us, the suspicion has not been confirmed. We would like to draw attention to this experience, as it can cause additional stress if criticism of one's own scientific communication is brought to the attention of the institute management or the ombudsperson.

What to do in the event of unobjective attacks on your own person?

Science communication – especially, but not exclusively, on social media platforms – can provoke derogatory or even threatening comments instead of fostering objective engagement with the topic. Anyone who is the target of hate speech, unobjective criticism, or attacks due to their science communication online can turn to the "ScicommSupport" initiative founded by the "Bundesverband Hochschulkommunikation" and "Wissenschaft im Dialog", for example. The initiative's website contains guidelines on dealing with attacks, training courses, and workshops. Particularly noteworthy is the hotline for telephone advice. This low-threshold service should be used! It is beyond the capacity of this guide to explore the psychosocial effects of science communication. However, they should be taken very seriously.

What should you do if a colleague is attacked in an unobjective or disproportionate manner?

Colleagues who are publicly attacked in an unobjective or disproportionate manner should be clearly supported, whether on a private level through a personal email or by asking how one can help. You can address such cases publicly, speak out firmly in favour of a factual discussion and against personal attacks, and make a correction, whether as an individual or in cooperation with a professional society.

It is also due to such attacks that many people decide not to engage in science communication. If only experts with a correspondingly thick skin and self-confidence communicate, we are missing the voices of a large group of scientists. Therefore, everyone should advocate for an objective and respectful discussion.

15 An ombudsman is a neutral and independent mediator who handles issues related to research integrity, ethical concerns, or conflicts within the scientific community. Their role includes investigating allegations of misconduct, ensuring compliance with ethical standards, and providing confidential advice to researchers.

Wishes for journalism – a utopia

In order to further develop communication between science, journalism, and society, we need to formulate clear goals. By formulating these ideals, we can at least approach them step by step. So, we conclude here with a utopia of science communication and a wish list for journalism and other social entities. Many of the points are already being implemented, but some need to be taken more for granted, and others may be a long way off. The list does not claim to be exhaustive and should primarily be read as an inspiration for constructive dialogue. In essence, we are picking up on the five key points from the first part here, as we believe they are at the heart of good science communication. Good science communication may only succeed jointly with journalism, politics, and society, which is why we need everyone's contribution.

Respecting the limits of expertise (LP1)

Scientists are usually not communication professionals, but they are happy to share their knowledge without restrictions. This may be different from politics or business, where decision-makers may not yet want to reveal their future strategy. It is therefore immensely important to assume in the interview that a deep understanding of the other person is the goal of both sides. Unfortunately, there are isolated cases in which scientists are pressured to make statements outside their area of expertise. There may be many reasons for this. However, it can be very uncomfortable, especially for less experienced scientists, to have to clearly delimit themselves here. Of course, these boundaries of the individual experts should be respected.

In order to cover the field widely and obtain expertise on a broad basis, it is usually necessary to approach many different scientists. If you only rely on a few possibly well-known faces in the media, you risk one-sided or distorted communication. In order to cover the breadth of specialist expertise, journalism can also specifically look for young, less well-known scientists in the media or ask other, well-connected scientists from the research field for contacts.

Always make the separation of knowledge and evaluation clear (LP2)

We would also like to see a consistent separation of knowledge and evaluation in journalism. This first requires a careful assessment of the state of knowledge. Only when a common discourse framework (and its uncertainties) has been agreed upon should a weighing of interests be undertaken. If there are already discrepancies in the discussion about the level of knowledge, then the weighing of interests and the conclusions drawn from them are often likewise different. Carefully asking what level of knowledge is being assumed can avoid unnecessary discussions.

In order to ensure a correct presentation of the state of knowledge in all departments, even closer integration with science journalism across departmental boundaries can be helpful. This would prevent chains of argumentation from being built up with outdated or implausible assumptions.

Less polarising headlines, more discussion of the state of knowledge (LP3)

How often was an article read and shared? How much advertising revenue or how many new subscribers did it generate? A high reach is, of course, important because an article can be as "good" as it is: If it is not read, it has no impact. However, how attention is generated and maintained in the long term is a complex question. If you rely on polarising headlines, you will initially attract attention. They will provoke contradiction, doubt, or at least questions. In some cases, readers will only find the realistic categorisation of this statement behind the paywall – inaccessible to many. The impression of an extreme statement remains. In addition, each media company has its own editorial line, which influences the selection and presentation of topics. This can sometimes lead to a "false balance" if outdated or implausible positions are given a lot of space. From our side, there is a desire to polarise less, to allow more time for research, and to share with the public the complexities of the issues at stake.

Who is an expert? Transparency in selection and conflicts of interest (LP4)

Experts are usually characterised by current, peer-reviewed specialist publications. If a person has no or only long-standing specialist publications on the specific subject area, it should be well justified why this person nevertheless contributes sound expertise in the field. This is not about ruling out alternative hypotheses a priori. The point is to emphasise that alternative hypotheses usually find their place in the specialist literature if they are reasonably plausible and solidly elaborated. Superficial speculations and very implausible hypotheses, on the other hand, are less likely to make it through the peer review process.

Transparency in the selection of experts makes it possible to reflect on whether the selection is appropriate. Traceability strengthens trust. It is also desirable to approach younger or less well-known people in order to cover the expertise in the best possible way. It would also be desirable if some (science) journalists had the opportunity to delve even deeper into a subject area in order to build a further bridge between broader journalism and highly specialised research.

In general, journalism should actively seek out, research, and report on potential conflicts of interest. Conflicts of interest can have various causes and influence communication in many different ways. The separation of knowledge and evaluation is just one measure that can reduce the influence of interests. Warning lights should flash if institutes are not independently funded; experts have hardly any publications in

established journals, comment far outside their field of expertise, or prioritise evaluation. To increase transparency, the criteria used to select experts should be disclosed.

Young scientists in particular can undermine their reputation if they are presented to the public as a counterpart to supposed experts with a conflict of interest. They may then appear to be working in a tendentious manner. If, for example, the supposed expert assesses the situation as red, but the communicating scientist classifies the situation as black based on the state of knowledge, the public could assume that the scientist would always assess the situation as black, regardless of the state of knowledge. Especially when it comes to politically relevant topics, journalism can make an important contribution to clearly separating the state of knowledge and interest-driven assessments in the debate.

The state of knowledge must be presented correctly (LP5)

Communicating the state of knowledge accurately and clearly is at the heart of science journalism. But not only in the science editorial team, but also in the other editorial departments, many articles refer to basic knowledge or new research findings. However, depending on the thrust of the (opinion) piece, scientific arguments may be oversimplified, used selectively, or even be almost completely absent, even though they would be immensely important. An even closer interlinking between the departments can help to ensure that the scientific principles are presented in all departments with optimum reliability and irrespective of what the topics were – whether climate change or wealth distribution.

Citing and linking sources

Of course, sources should be named and linked not only in science but also in communication, as far as possible. This clearly applies to scientific sources. But even if you refer to other media ("as reported by the children's newspaper"), these articles and sources should be linked so that readers can understand the derivations.

Identifying versions

With the increasing influence of artificial intelligence (AI) on journalism, media content can be increasingly individualised. Different headlines are already being tried out for the same article, changes are being made without identifying them as such, and articles are being updated or adapted to the profile of the specific reader group. A "unique identifier" for each version would be desirable here so that everyone (including journalism research) can understand which variant or personalised version is meant. Transparency can build long-term trust.

Space for specialists

The workload in science and journalism can be immense. In order to relieve the burden on scientists in communication, specialists could be strengthened at the interface between science and (science) journalism who have both very sound knowledge in their field and outstanding communication skills. A separate career path for scientists could be developed here. Such experts could promote and strengthen the dialogue between science and the public for a wide variety of target groups (journalism, politics, the public, ...).

Slower communication

Scientific projects often take many months or even years. Journalistic and social issues, however, like to be dealt with within hours or days. As a result, the experts who respond the fastest are also more likely to be heard. For some topics, however, detailed elaboration is helpful – but the results may come much later. A good balance between quick but nevertheless well-founded initial assessments and in-depth analyses is important so that all voices, the quick and the slower ones, are heard. Overall, we would like to see slower communication.

Separation of knowledge and interest-driven evaluation

In times of fake news and strategies such as "Flood the zone with shit" (Steve Bannon), we believe it is even more important to clearly differentiate interest-driven assessments and supposed knowledge, which can appear professional from generously funded lobbying institutions, from the actual state of knowledge. This requires research time and transparency on the part of journalism. We scientists are happy to contribute to this.

No attacks ad personam

Scientists have many reasons to get involved in science communication. However, there are also many reasons not to do so. These include the risk of being exposed to personal attacks. The risk of such an attack alone means that many scientists *do not* communicate, especially in heated debates. We lack these voices in the discourse.

Don't ask yes or no, but "How much?"

Many misunderstandings can arise because a certain position[16] is advocated instead of asking "how much" something helps or costs – and under what assumptions. The pros and cons have their place in the discussion of value, but in the communication of the state of knowledge, they are of secondary importance because there is usually a "true" value that one wants to estimate scientifically. Controversies can often be resolved by asking about the assumptions and then naming a plausible effect size (instead of talking about extreme scenarios).

16 e.g., "Vaccination helps prevent infection" versus "Vaccination does not protect against infection" versus "Vaccination reduces the probability of infection by X percent."

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Methodology

This guide to science communication was developed by us as young scientists to support (young) scientists in effectively communicating their research results. The aim is to provide a collection of guidelines and concrete tips from and for scientists. The Delphi study method was adapted to develop consolidated recommendations through iterative surveys and feedback rounds. This methodology was chosen in order to gather broad and well-founded expertise from various relevant areas and perspectives.

The interview partners were selected based on their expertise and experience in the fields of media, science communication, research, and politics. A total of 11 experts were interviewed for one hour each and included in the study. The resulting text was sent to a broad group of experts for feedback, and the feedback was incorporated.

A comprehensive list of questions was developed for the interviews to cover the central topics of science communication. The interviews were conducted and recorded via Zoom to enable a detailed analysis. The transcripts were taken by several interviewers. The transcripts were then collected centrally. Guiding questions were sent to the experts in advance to enable preparation. In order to ensure anonymity and confidentiality during the interview, the interviewees were free to decide whether or not they wanted to be named as interviewees in the appendix to the guidelines.

A comprehensive literature search was also conducted to identify relevant literature. The information gained from the interviews and the literature research was evaluated by the authors of the guidelines. Recurring themes were identified and systematically summarised into central guiding points, tips, and a utopia of science communication.

Key findings were presented at the Forum Wissenschaftskommunikation in November 2023 and at WissKon24 – the NaWik's conference for communicating researchers – in April 2024, and further feedback was collected in group discussions. In the course of the process of creating the guidelines, versions of the text were repeatedly presented and made available to the members of *Die Junge Akademie* for feedback. The feedback received was continuously incorporated into these guidelines. It is the result of this iterative process. The guide is published both on the Die Junge Akademie website and in printed form, making it accessible to a broad public.

Useful Links, Sources, and Literature

The sources collected as part of the literature review for this publication are presented below, categorised into guidelines and statements, specialist literature, and institutions, groups, and associations.

Guidelines and Statements:

Borowiec, B. G. (2023). Ten simple rules for scientists engaging in science communication. *PLOS Computational Biology 19(7)*: e1011251. https://doi.org/10.1371/journal.pcbi.1011251

TU Dortmund: "*Leitbild Gute Wissenschaftskommunikation*", as of 2/2023

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Nationales Institut für Wissenschaftskommunikation, ABC der guten Sprache, July 2022

German Council for Public Relations (DRPR): "*PR Richtlinie Wissenschafts-PR*", June 2022

German Science and Humanities Council (WR): *Impulse aus der COVID-19-Krise für die Weiterentwicklung des Wissenschaftssystems in Deutschland.* 2021

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Alliance of Science Organisations: *10-Punkte-Plan zur Wissenschaftskommunikation,* May 2020

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Institutions, Groups, and Associations:

Forum Wissenschaftskommunikation

Informationsdienst Wissenschaft e.V. (idw)

Nationales Institut für Wissenschaftskommunikation gGmbH

scicommcollective.com

Science Media Center

TU Dortmund: “mediendoktor.de” – ongoing updates

wissenschaftskommunikation.de

Wissenschaftspressekonferenz e.V., Est. 1986

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Die Junge Akademie

Die Junge Akademie
at the Berlin-Brandenburg Academy of Sciences and Humanities and the German National Academy of Sciences Leopoldina

Die Junge Akademie was founded in 2000 as the world's first academy for outstanding young scientists. Its members come from all scientific disciplines as well as from the arts; they explore the potential and limits of interdisciplinary work in new projects, want to bring science and society into dialogue with each other and bring new impetus to the science policy debate.

Die Junge Akademie is jointly organised by the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW) and the German National Academy of Sciences Leopoldina. The office is based in Berlin.

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