Executive Summary

Science Communication

We understand science communication as any contact established and maintained between science and non-science, i.e. with science's environment, either directly or through intermediaries such as communica-tion professionals. Science communication makes scientific topics, approaches and results visible to non-science in such a way that external addressees can perceive them as relevant.

Science communication may aim at contributing to problem-solving and at informing general public(s). Accordingly, three groups of science communication are distinguished in the text: (1) oriented primarily towards problem-solving, (2) oriented primarily towards generation of visibility and (3) equally oriented towards both problem-solving and visibility. These three groups, in turn, are divided into eight basic forms of science communication, which all bridge the boundary between science and non-science.

Our model limits and at the same time expands the understanding of science communication. It delimits external communication of science (science communication) from inner-scientific communication (scholarly communication). Expansion refers to the fact that all forms in which science establishes and maintains contact with non-science are included in this model.

The Corona crisis led to public crisis communication, which primarily emerged as political and administrative communication. Due to the impossibility of managing the crisis without engaging with existing and newly produced scientific knowledge, however, political-administrative communication was also directly linked to science communication – in the form of what we call crisis communication of science. This com-munication established or expanded communicative channels between science and society in order to feed research knowledge relevant to the pandemic into the general, public crisis communication.

In the above-mentioned system of science communication, Corona-related crisis communication of science belongs to the group 'oriented towards problem-solving and publicity' as it involves both contributions to problem-solving and informing the public. Within this group, it is located in the sub-group 'crisis aid communication in the public interest' (science becomes active as an emergency helper in a situation of social upheaval), resulting in the overall usage of communication forms such as knowledge transfer, policy advice, public relations maintenance and science journalism. Understood this way, science communication is not exclusively public communication – but it is so to a large extent. Knowledge transfer and advisory processes, even in the pandemic, do not constantly take place in public. Depictions of science in the media and science popularisation, on the other hand, are only conceivable as public communication.

Phases of the Pandemic and Science Communication

In the first phase of the Corona pandemic, its phenomena were communicated by a rather small set of actors, including some scientific experts. The more unknown the phenomena of a crisis were, the more this phase focused on the transfer of basic information. Those affected attempted to transform a 'danger,' i.e. a situation that cannot be calculated, into a 'risk' that can be calculated and thus dealt with. In a second communication phase, the crisis was embedded into a wider array of social settings: Further consequences and effects on society as a whole were debated. This resulted in a phase of reflexivity and risk assessment: It became increasingly clear that certain ways of dealing with the crisis entailed further risks.

This phase was characterised by an expansion of the range of crisis-related topics as well as participants in the discourse, but also by expanded controversy regarding scientific knowledge. In a third phase, the crisis communication was mainly about management, i.e. the implementation of pandemic-related measures, their successes and limitations as well as any consequences associated with their implementation. The fourth communication phase – yet to be reached – occurs after the actual crisis. In this phase, the crisis is evaluated retrospectively, insights for future crises are communicated and/or the crisis and its victims are commemorated in public.

Communication Events

During the crisis central and peripherical communication events occurred that were (a) related to the pandemic and (b) related to science as well as (c) bridging the boundary between science and non-science. Both central and peripherical events influenced the status that science could achieve via communication in responding to the pandemic: Central events were those that determined the communicative course or led to drastic changes in perception in the public or specific sub-publics or that were not immediately neutra-lised by subsequent communication events, but could gain sustained validity. Although peripherical communication events did not bring about any significant changes in perception or debate on their own, they

formed part of larger sets of events that gained significance.

Thirty central science communication events could be identified for the years 2020/2021, i.e. an average of 1.25 per month. These can be ranked in terms of frequency as follows:

- non-commissioned policy advice: nine events
- commissioned policy advice: 7.5 events (one event assigned to two categories)
- science popularisation: six events
- institution-bound outreach / information of the public: three events
- debates with sensitive impact on science: 2.5 events (one event assigned to two categories)
- anti-science journalism: two events

It emerges that with 16.5 events the policy-advising activity of science – requested as well as unsoli-cited – was dominant. This shows that, in addition to the oral advisory processes, a classic format of sci-ence communication was of outstanding importance: the written (policy advice) paper. On a side note, six of the central communication events took place exclusively online and/or in non-textual form.

Dominant Forms of Communication

The various formats in which pandemic-related science communication was conducted continuously merged, related back to each other and were linked via referencing. Multi-channel communication and a crossover of different media formats were widespread. These processes made it clear that science is inde-ed 'medialised,' as Peter Weingart has called it: Science adapts its forms of communication to the de-mands of the media system in order to survive in the attention economy against other actors with compe-ting interpretive power. All this proved helpful to spread scientific knowledge throughout the pandemic. As many channels as possible had to be used as quickly as possible, since the audience's media usage behavi-our was constantly shifting, yet crisis management required broad resonance for relevant pieces of infor-mation.

One mode of communication that has often been championed as the best tool in the box, however, has hardly figured during the pandemic: multidirectional science communication. This in spite of the fact that the boundaries between science and scholarly communication have become more permeable, which would have helped its rise. The general goal of multidirectional science communication is to move from a deficit model (science teaches, the knowledge-deficient public learns) towards a greater involvement of the public in science. Yet, our research shows no discernible push for multidirectionality in science communication during the pandemic.

If the science communication events and the processes of pandemic-related science communication are analysed together, the dominant forms of communication become clear. These were policy advice, public relations and (science) journalism. Scientific policy advice usually contributes to bridging the gap between explanation and decision as it translates scientific knowledge into applicable information, transferable concepts and actionable knowledge. Across the board, the increased use of responsive media was discernible. Research transfer also proved to be significant for the management of the pandemic.

In terms of content, crisis communication of science primarily attempted to bring together the scientific experience of experts and to systematise this expertise into key points. With regard to the relationship between sender and addressee, two variants of scientific advice were used in the pandemic:

- advisory offers to policy-makers, a kind of outreach policy advice, and
- papers and statements issued at the request of policy-makers.

Both were often subject to fierce challenges of various kinds, and in the case of requested advice, this was always accompanied by a discussion of its relationship to its client, i.e. politics. Requested advice was ac-cused of being too close to the political arena, i.e. its independence was questioned (e.g. all recommenda-tions calling for a lockdown). Or they were accused of being too far removed from politics in the sense of practicability, i.e. their closeness to reality was questioned (e.g. advice given by the Standing Committee on Vaccination).

With regard to what advisory communication of science can look like, the crisis has shown the whole spect-rum of possibilities:

- commissioned and non-commissioned policy advice,
- formulation of scenarios, options for action or policy demands,
- sometimes, but not always, accompanied by socio-political assessments

In this context, normative assessments and recommendations for action posed particular challenges for science communication because:

- Assessments and recommendations can be conflictual.
- Their formulation neccessitates unambiguity, which can overstretch information available for scientists at a given moment.
- They can perforate the boundary between analysis and decision
- and thus the boundary between the roles of scientists and users of scientific knowledge.

Nevertheless, considerations that scientific policy advice should only describe contexts and merely formulate options for action have been overturned by the pandemic. However, the fact that advice was by no means only delivered in the (presumed) interest of the client was evidenced by the fact that dissident voices from the scientific community also made themselves heard. Moreover, politics was so heterogene-ous, contradictory and sometimes chaotic that even a willingness to follow political actors, if it existed in academia, certainly would have had a hard time. At the same time, a central function of policy advice, which is fulfilled independently of concrete counselling effects, was also confirmed in the pandemic: The mere fact that counselling takes place is already a form of legitimation. Nothing necessarily follows from this, as having received advice does not oblige one to act. But what one does can be more convincingly defended if it can be presented as the result of having received wise counsel. Policy advice, insofar as it was delivered in the format of written statements, was mostly transparent to the public: Usually the texts were immediately accessible online.

As public relations is communication by organisations (universities, institutes, research organisations or professional societies), it always serves to safeguard those organisations' own interests and thus was particularly important in the pandemic by linking contributions to the pandemic response with the visibility of the performance of one's own organisation. The primary addressee of such efforts was (science) journa-lism, through which the non-scientific public was addressed. Science journalism – as part of the media sys-tem – strengthens the communicative efforts of science to maintain contact with non-science, but combi-nes this with a critical approach typical of journalism. It could be observed that from the very beginning of the Corona crisis the scientific information conveyed via public relations was not focused solely on medical topics. Rather, the entire range of scientific subjects was covered. However, it also became apparent that the non-medical disciplines had to continuously fight for visibility.

Two pecularities became even more pronounced during the pandemic:

- First, science journalism was not only delivered by science journalists. Due to the contingent change of priorities, it diffused into practically all departments of journalism.
- Second, the media-specific approach to delivering content – personalisation, polarisation, exaggerated formulations, sometimes inappropriate simplifications or emotionalisation – could reduce the value of in-formation.

The pandemic saw a rapid increase in the use of social media platforms and responsive media for science communication, both in terms of supply and demand. Nevertheless, the pandemic also showed that responsive media was used far less frequently in Germany to obtain information than conventional mass media (in their analogue and digital forms). Nevertheless, pandemic-related science communication had to incorporate additional demands made by the online media environment.

This was demanding because the possibilities for information to resonate differ significantly from offline media. In particular, the digital media sphere generates a tension with the 'slowness' of science's genera-tion of knowledge. Digital reception speeds are accelerated, attention spans reduced, and tolerance of ambiguity can be underdeveloped. One element of these developments was that non-experts – often in their capacity as experts for 'real life situations' – also evaluated scientific results and achieved a high level of resonance in the digital sphere. The amplified effects of such critical assessments of scientific results by lay persons forced the science system to react, albeit not every external commentary follows the rules of objectivity, freedom from contradiction and acceptance of competing views usually attributed to scientific discourse.

Academic Disciplines and Speaker Positions

Knowledge transfer is one form of contact between science and non-science that translates scientific knowledge into contexts of practical application. Scientific knowledge is processed in such a way that it can be used in other social contexts according the contexts' needs. This translation can also mean that rese-arch questions are defined in an act of co-production between science and practice fields. A significant instance of knowledge transfer in Germany was realised by developing the BioNTech vaccine.

Initially, virologists and epidemiologists monopolised public communication on the pandemic. Yet, they are no experts on the social, political, cultural and economic consequences of a pandemic. Consequently, the social sciences and humanities also discussed new development(s), noticeably from April 2020 onwards. However, these disciplines continuously had to fight for public resonance. The classic mass media success-fully tied experts of medical and – with some delay – natural science to specific (sometimes rival) formats. These experts thus also expanded their non-scientific prominence.

In responsive media, influencers gained notoriety on their own: While in conventional media, scientists were built up as leading figures in science communication because they had a (certain level of) reputation as researchers and combined this with communicative skills, infuencers only needed the latter. They were closer to those scientific experts who have a good reputation as communicators and combine this with scientific knowledge they extract from their reception of the work of others; yet, without being able to distinguish between scientific and non-scientific claims in the fast-moving world of pandemic-related rese-arch. The ex-

pert successful in responsive media provides a strongly target group-oriented translation of expert knowledge that others have at least co-produced. This type of expert is found mainly on video plat-forms.

Scientists of the type described above, however, also pose a risk for science communication: The public usually assumes they are part of cutting-edge research because of their academic titles and high positions in academia. This misperception becomes problematic when scientists who merely synthesise other's research formulate recommendations, often in an opinionated manner.

In the humanities and social sciences, this initially centred on academics with a talent for diagnosing the present. Via their statements, one could watch them think in real time, so to say, insofar as the production of knowledge, opinion and scientific communication coincided in their public discursive acts. After initial research had taken place, empiricists could supplement these tentative observations of social scientists.

In the course of the pandemic, two typical speaker positions emerged: (1) the scientist who communicates in public and (2) the scientist who semi-publicly advises on policy. Both roles could also coincide in one per-son. While the public communicators were present in the media, the political advisors either participated in appointed expert committees or were involved in advisory groups organised on their own initiative. In the latter, they appeared less as experts in their respective fields and rather mixed the roles of 'expert on issues affecting society as a whole' and 'public intellectual.'

An alternative model to those mentioned so far is the 'destructive science communicator' – a type that intentionally aims at destroying dominant speaker positions by means of exclusionary communication. Supported by a reputation derived from professional expertise or a (claimed) proximity to it, the destructive science communicator develops and disseminates heterodox positions, which often result from one-sided selection and interpretation of academic research and thus become partly or entirely scientifically spuri-ous.

By doing so, all participants entered conflictual arrangements in polarised public debates. This was especi-ally true in the case of deviations from the scientific or/and political mainstream. Polarisation, by focusing on the argumentative bookends of debates, also led to narrowing discursive space: On the one hand, discussions of fundamental legal, philosophical or sociological problems arising with and from the pandemic were always read in two ways: What possible criticism of current pandemic-fighting measures might be 'hidden' within them? And what could follow from this if one were to think them through to the end (which, in many cases and contrary to widespread opinion, would be quite possible in different directions)? On the other hand, this not only marked certain positions as precarious, but also made entire topics taboo, such as the problem of massive deaths in old peoples' and nursing homes without end-of-life care by relatives.

Arguments by serious scientists who were nevertheless stereotyped as deviants re-emerged when the first systematisations of problems with the management of the pandemic were presented by the German National Academy of Sciences Leopoldina and working group of the prestigious WZB Berlin Social Science Center. Both produced their papers for a select committee that reviews the handling of the crisis and aims at developing reform proposals for future crisis management.

Plural v. Inonsistent Communication

It turned out that public communication of science was plural and that of politics inconsistent. Communica-tion disasters occurred in both realms. Some of these disasters were understandable, since completely new communication tasks had to be mastered. In part, however, they revealed deficits in professionalism that merely documented poor craftsmanship. When the involvement of various disciplines above all gave the impression of an inexplicable polyphony, or when a political decision that was represented as 'backed by science' found itself scientifically criticised after a short time, then the public's willingness to participate in scientific communication was quickly exhausted.

This is problematic as the polyphony of results arising from scientific research was perceived as communicative cacophony. This also touches on a basic problem of science communication: Science must defend a certain state of research which currently has the highest degree of certainty. If it wants to be heard outsi-de of its own circles, science cannot continually operate with rhetorical figures that give expression to the spirit of doubt that is typical of science. It must therefore employ a rhetoric of certainty that can be justifi-ed solely by the fact that all other available knowledge has lower degrees of certainty. At the same time, this creates expectations – for example, about predicting the spread of viruses – that may not be fulfilled with the information at hand. Disasters in political crisis communication exacerbate the problematic effects of science communication disasters. In contrast to science communication, however, political communication was continuously in a state of emergency. But the fine distinction between the plural (sci-ence) and the inconsistent (politics) was hardly communicable to the public. Thus, the impression of a ca-cophony was created in both realms.

Competing Knowledges

During the pandemic, as in every crisis situation, in addition to widely shared knowledge ('common ground') and competing new knowledge from research, two other types of knowledge became significant: ignorance and erroneous knowledge. Ignorance had to be taken into account because the pandemic raised issues that had not been dealt with before, e.g. mask efficacy or the importance of aerosols.

Knowledge deficits become problematic for science communication especially when the public needs knowledge on a respective topic and therefore expects clear guidance. In such a situation, science has only three options for communication: (a) to remain silent, (b) to operate with plausibility-supported assumpti-ons by using knowledge that is available from (actually or supposedly) comparable situations, or (c) to dis-cuss opinions instead of knowledge. In short: avoid communication or do it on shaky ground. All options have the disadvantage that they do not strengthen trust in science and may even contribute to its erosion.

On the other hand, ongoing controversies about scientific knowledge (e.g. on climate change), in connec-tion with society's supposed declining tolerance of complexity, is a potentially insightful framework for dealing with similar situations. In the pandemic, erroneous knowledge was also communicated within the framework of destructive scientific communication – e.g. 'corona is akin to influenza.' Here, scientific ad-vice addressed at policy-makers also provided deniers of the need for active pandemic control with argu-ments that constituted science communication at least insofar as some of the senders had the authority of their professional position.

But the pandemic also generated a strand of communication that gave interested parties the possibility to address questions of the status and validity of scientific knowledge in general. This communication existed as a permanent meta-communication that accompanied the science communication related to factual information. Differnt forms of knowledge (generation) and their claims to scientific validity were presented and thus an epistemological problem was discussed in the public sphere. In this respect, the Corona crisis communication of science was also a crash course in 'philosophy of science for everybody' and promoted literacy about problems of scientific research to the public. The public's ability to simply acknowledge sci-entific facts and explanations as universal truths was challenged in the process, which could assist future debates on socio-scientific problems.