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Position Paper

Social Media and Digital Science Communication

Analysis and Recommendations for Dealing with Risks and Opportunities in a Democracy

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Supplementing this position paper, the anthology „Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter“ (Weingart et al. 2017) publishes the expert opinions created by the working group as well as further contributions by individual members and experts.

Social Media and Digital Science Communication

Analysis and Recommendations for Dealing with Risks and Opportunities in a Democracy

Preface

The relationship of and communication between science, public, and media is facing new challenges against the background of advancing digitisation. Already in 2014 the academies published some recommendations on these interactions in 2014. These recommendations were strongly received, and partially implemented. Back then, the focus of analysis was on transformations in classical media. Digital media, and especially Social Media, themselves also responsible for the dynamic development of the media landscape, require separate consideration, thus the result of the working group. The present publication ties in directly with the 2014 paper, analyses some possible effects of digitisation on different forms of science communication in a democratic society, and generates recommendations, with a primary focus on external science communication.

Observing the effects of Social Media on science communication lead the working group to an area of observation, which turned out to be even more dynamic than expected. Virtually every week new developments made seemingly consolidated observations obsolete. Already during the project duration, the immediate effect of Social Media on political decision-making processes became apparent, even though it cannot be determined in detail. Already the intensified discussion on “fake news” and hate speech in late 2016, and the resulting increased political pressure to, for example, use media laws to regulate, caught up with considerations in the present text, which still seemed daring in early 2016.

This extraordinarily dynamic development in the fields of digitisation, internet, and Social Media gives the present analysis and the following recommendations high topicality. However, the necessity of dealing with this topic in continuous observation and systematic analysis has to be recognised.

This position paper was authored by a working group consisting of scientists, journalists, and science communicators of research institutions. It underscores the urgency for further research and gives impulses to take action in the field of activities described, thus contributing to prevent undesirable developments.

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1. Summary

The internet and so-called Social Media revolutionised public, private, and political communication, as well as science communication. Formerly existing boundaries between the actors and institutions participating in science communication are becoming porous, and the rules and standards valid in each single field become blurred. This is especially true for scientists and their institutions, whose work, besides its publication in specialised journals and occasional journalistic coverage, is often made accessible to the wider public on the internet even before its verification by other scientists.

While the broader public's perception of science is still strongly determined by journalistic mass media, they mostly have lost their role as gatekeeper; besides Social Media they are just one (however important) part of mediated publics. The use of digital distribution has made it much easier for research institutions or individual scientists to communicate directly, or via their public relations office, with the broader public. This opens up new questions, for example on the standards of an honest and appropriate self-mediated (in contrast to other-mediated or externally observing) science communication; but also much more fundamental questions, for example on the demand for specific forms of regulation using media laws to preserve a science communication oriented towards diversity, relevance, and truth and accordingly evidence, including a science journalism both critiquing and controlling.[1]

These expanded options for communication take increased dialogical and participatory demands into account. Negotiation and involvement have increasingly joined information on the scientific agenda (and for classical mass media as well), sometimes even associated with expectations of an increased democratisation of science. This interest in science and its potentially increased visibility is contrasted with a previously unknown wealth of available scientific (and non-scientific) information, which often makes distinguishing reputable from disreputable arguments quite hard for the user. At the same time, science communication is now part of an even more direct competition – for the attention of the audience, for the selection by computer algorithms of private intermediaries, but also for credibility in comparison with messages that are often easier to communicate or even with targeted misinformation (for example "pseudoscience"). These media technologies, new and already established intermediaries (cf. box on page 12) like Facebook and Google and the simultaneous dissolution of many journalistic models of monetisation transform the relation between science, public, and media. New media practices and forms of communication open up opportunities, but also represent risks for society.

As the common good cannot be negotiated by the procedures of direct democracy alone, but is established in legal and political institutions of the polity, and especially in the law itself, the sphere of public communication can also not be left to the free play of (market) forces. Instead it has to be structured in light of and for

1 Cf. Blattmann et al. 2014.

the protection of freedom of speech and information grounded in the constitution. With regard to the central importance of science for individual and collective decision-making processes in a democratic society, the interaction of participation and regulation in science communication has to be redefined.

As virtually always happens with the introduction of new technologies, the digital medialisation of science is greeted by euphoria by some and horror scenarios by others. The working group set up by the academies made justified observations, above and beyond techno-utopian or -dystopian exaggerations, which should enable a more realistic assessment of risks and opportunities. The resulting recommendations highlight possibilities for regulation, for neutralising threats to the constructive interaction between science, public, and media, but also measures to strengthen this interaction. Notwithstanding the state of research severely lagging behind real-world developments, providing science and politics with analysis and information regarding the increasing importance of Social Media turns out to be an important goal at the moment. Preserving independent journalism, strengthening media competences and evaluation of sources in the population, as well as research and (self-) observation of science communication in the age of digital media are irrefutable political desiderata. Taken together, they form the requirements for permanently safeguarding democratic decision-making processes based on reliable information.

On the basis of these considerations, the working group of the academies derives the following recommendations for action, which are presented here in brief (their expanded versions with explanations can be found in chapter 4):

Recommendations for Politics

Recommendation 1: Apply media laws to regulate platforms and search engines

The profound structural transformation in public communication should be accompanied by political measures. Platforms for Social Media need to be included in regulation, due to their relevance for the democratic public sphere (power of opinion). Structural diversity and user access to information, media, communication, and knowledge markets need to be secured, and market-dominating positions, for example of a single search engine, need to be countered. Social Media platform and search engine providers have to be increasingly regulated from the perspective of journalism and media law, instead of primarily with respect to economic and anti-trust regulations, as is generally the case until now. The observations and discussions of the media authorities of the Federal States might be starting points to be pursued further. The legislature has to safeguard the uncensored access to socially relevant sources of information and knowledge for all citizens. For this, regulatory requirements for providers of platforms or search engines (for example with respect to filter algorithms) may be necessary.

Recommendation 2: Safeguard the independent supply of information on the internet

In order to make the supply of information on the internet less dependent on the influence of individual providers like Google, Facebook, Twitter etc. and respond to the problem of filter bubbles (see page 24), the legislature and politicians working on media, education, and science policy on the state and federal level have to develop long-term measures in collaboration with relevant actors. Specifically, they should examine the legal, structural, and content-related possibilities of developing a journalistically independent nationwide platform for information and science

communication with content intelligible to the broader public. The responsible editorial staff has to work independently of government and science organisations under an editorial and advisory board. The legislature should call for an expert commission, consisting of representatives of public broadcasters, publishing houses, journalists associations, Social Media experts and representatives of science PR (for example idw), the Science Media Center, and of educational institutions, in order to examine to actual feasibility and, if necessary, the planning and formation of such a platform. This expert commission has to deal with legal questions (for example the aggregation of third-party content), possible economic effects on the business of model of private-sector science journalism, as well as the specific technological elements of such a platform, in depth.

Recommendation 3: Strengthen the education and information mandates of public broadcasting

Public broadcasting remains indispensable for the elementary provision of information and knowledge for society. It needs to be enabled to increasingly provide targeted services within the field of science communication and online as well. In the light of their special responsibility and guaranteed funding, public broadcasters should specifically expand their journalistic services on the topics of science, technology, and medicine as part of current affairs. We recommend stronger connections of main programming with cross-media services. The education and information mandates are to be strengthened in relation to the entertainment mandate.

Recommendation 4: Support science journalism following the model of research funding

Further possibilities for funding and supporting independent journalism, especially by foundations and the government, should be examined in the light of an already precarious funding situation (for example for independent journalists). Funding decisions could follow models of research funding (funding of quality journalism on the basis of expert/jury decisions with significant involvement of journalists, similar to film and scholarship funding). As government activities in the media and communication sector are problematic with respect to democratic theory, a model of (co-)funding government-independent foundations, which then initiate funding measures, is worth discussing. Here as well the funding principles of science may be used as a model.

Recommendations for the scientific community

Recommendation 5: Avoid false incentives in science communication

Scientific organisations and funding institutions are called upon to carefully consider unintended side effects and possible dysfunctions when providing incentives for communication of research results (for example using measures of attention or reach) and for communicating with the public (for example rewarding “outreach”).

Recommendation 6: Evaluate costs and benefits of institutional science communication formats

Specific training courses should make it easier for interested scientists to find their way into classical media and use of Social Media. An obligation for such communication, however it is devised, should be avoided. Furthermore, to counter the spread of media logic to the core tasks of research and teaching – for example by misallocation of resources (staff, material, equipment) – further internal mechanisms like strategic planning and cost-benefit analysis need to be established.

Recommendation 7: Separate fact-based science communication and science marketing

The possibility of direct communication with the final user, without prior assessment by (ideally) independent journalists and editorial staff, brings further responsibilities for self-mediated science communication. Press and public relations work of scientific organisations have to be clearly identifiable as institutional communication. Scientists have to be more transparent with regard to their communicative roles (see recommendation 10). Standards of scientific integrity and quality control have to be strictly followed, also in external communication. Departments dealing in (fact-based) science communication have to be clearly separated from marketing departments (primarily dealing in "reputation communication") – comparable to the structural separation of editorial staff and advertising department in journalistic publishing houses.

Recommendation 8: Develop a code of conduct for the web and Social Media

We recommend the development of proposals for a quality-oriented code of conduct for information on the internet and especially on Social Media in a working group with different actors. Its development should span different institutions and associations, with involvement of the Social Media community and its rules ("Netiquette 2.0"), as well as the professional and quality standards of journalism (for example good scientific practice, press code). This aims at covering gaps in government regulations. Possibilities for verifying the authenticity of contributions (for example identifying contributions by so-called social bots) should be further expedited.

Recommendation 9: Promote technological impact assessment of digital media

In light of a rapidly transforming science communication, its observation should be permanently institutionally embedded within the sciences (for example at the academies) – as part of a technological impact assessment identifying the influence of digital media on the communication and opinion-forming processes in a democratic society dependent on reliable scientific knowledge.

Recommendation 10: Strenghten public communication and demarcate roles

Scientists are encouraged to introduce their expert knowledge into public discourses and political debates, and, if necessary, take the initiative. Here, Social Media opens up opportunities beyond traditional media. However, the principles of "integrity in communication" (see 2014 recommendations) have to be observed, and responsible use has to be made of time and financial resources available beyond research and teaching. Furthermore, in order to avoid endangering the credibility of science itself, the role in which scientists and especially scientific officials take part in debates (for example as expert, teacher, private person, representative of a research institution) has to be clear at all times.

Recommendations for educational organisations and research policy

Recommendation 11: Improve media competence and evaluation of sources in schools and other educational organisations

In light of vanishing possibilities of matching information in digital media with their underlying sources and thus assessing its credibility, we recommend massive measures for acquiring and improving digital media competences and evaluation of sources in schools and universities, but also in vocational education, trainings, and further education. In this, evaluation matrices for information and intermediaries need to be conveyed, and an understanding of the working and selection criteria of digital media needs to be created. Aspects of data and privacy protection also need consideration.

Recommendation 12: Further research on the effects of digital media and establishing of responsive funding lines

The working group postulates considerable demand for further research on the workings and effects of digital media on science communication and provides a catalogue of relevant topics (cf. page 51). With regard to research funding, the establishment of funding lines with funding duration, funding scope, and speed of funding decision, enabling research to keep pace with the extreme dynamism in the field of public communication, is recommended.

2. Introduction

2.1 Recent Upheavals in the Media Landscape

The first decade of the new millennium also displays a new quality of the social impact of digitisation. With the establishment of Social Media (cf. box) like Facebook (founded 2004) and Twitter (2006), the conditions of social and political communication have been fundamentally transformed. By now, the diversity of Social Media formats on offer is hardly manageable (see Figure 1).

The traditional, mainly unidirectional mass communication, continues, but is faced with strong competition by digitally enabled multidirectional communication. The previously existing intermediaries (see box) of mass media, that is editorial staff, have lost their dominant position to technologically generated platforms, which potentially enable the direct communication between all members of society.

When new technologies are introduced, the initial public reactions are virtually always undifferentiated, either positive or negative. Here, conflicts of norms and rules should be expected. The internet and the Social Media platforms built on top of it revolutionised communication media and will, in hindsight, probably be evaluated as being even more radical than the introduction of radio and television – their invention has already been compared to that of movable type.[2] What most differentiates the internet from all previous mass media, is first the direction of communication, which no longer primarily moves into one direction, emanating from a central sender, and secondly, the low utility costs, which make it available for everyone. Communication is thus "blurring the boundaries", with respect to both participation and reach, giving rise to social developments which are still not fully understood. The reactions to the gradual transition from mass media to digital media – on the one

Social Media

"Web 2.0" refers to the use of internet formats specifically enabling participation and interaction. The collective term "Social Media" for such formats has been established in practice as well as in scientific discourse. Social Media include individual formats like blogs and podcasts, usually operated by a person or an organisation, as well as collective formats like social network sites (SNS, for example Facebook), microblogging services (for example Twitter), video and photography platforms (for example YouTube, Instagram) and wikis (for example Wikipedia), where a great number of networked users collaborate within a single service.

Further sources: Neuberger 2014; Brossard 2013; Schmidt 2013; Leßmöllmann 2012; Ebersbach et al. 2016

2 Cf. Baecker 2007 with regard to the computer.

Intermediaries, Gatekeeping and Curation

The term **intermediaries** means at first and generally the classic mediating services of mass media journalists and editorial staff. Intermediaries also function as **gatekeepers** for broader publics, by selecting, evaluating, connecting, and comprehensibly presenting information before publishing, according to specific criteria (for example its news value). While individual actors could previously reach broader publics only by means of these intermediaries, the increasing internet use and spread of Social Media has fundamentally transformed this situation. Here, **new intermediaries** develop; the Social Media platforms and their providers (for example, Facebook, YouTube, Google, Twitter, or more science-oriented portals like ResearchGate or Slideshare). They are a combination of software systems, provider interests, and user practices, and algorithmically bundle filtered information to continuously updated "streams" or "feeds". They are further oriented towards their users by providing personalised information services. Beyond that, they facilitate the increasing blending of conversation and publishing.

However, the role and workings of these platforms as mediating instances is still insufficiently transparent and research is lacking. They potentially enable everyone to publish information without the classical editorial filter mechanism of gatekeeping coming into effect. The selection, compilation, recommendation, and other interferences of these platforms are often called curation (in contrast to gatekeeping).[3] In **curation**, published content of all kinds is rearranged, commented, and evaluated according to specific criteria by human beings (curators), but often also by programmes (algorithmic curation). The timelines of social network platforms like Twitter, Facebook, or ResearchGate, but also the homepages of blog portals, YouTube, or other internet platforms, providing a continuously updated overview of selected content, are examples. There are also journalistically-oriented platforms (for example Blendle, Scope (formerly Niuws), Piqd, etc.), who are specialised in the curation of content produced by others. In this context, the question of whether and how curation could or should be a new task for journalists is discussed as well. While new intermediaries generate no scientific knowledge themselves, they significantly contribute to users finding and spreading it (see chapter 3.3).

Further Sources: Davis 2015; Fotopoulou/Couldry 2014; Gennis/Gundlach 2014; Jarren 2008; Hollmer 2015; Lobigs 2016; Michal 2015; Schmidt 2017

hand a form of scaremongering critical of contemporary culture, on the other hand hyperbolic enthusiasm – are similar to reactions to new systems of media in the past. In light of the unsettled state of research, our current situation does not enable us to decide which assessments will eventually be justified.

Especially the possibility of a direct dialogue initially led to an ecstatic reception of Social Media, promising a comprehensive democratisation of society, among other. Social Media in particular was to bring forth a closer and more personal relationship between politics (but also science) and the population. The latter was thereby enabled to more quickly and precisely acquire information on specific topics. This type of transparency, so the promise, was to enable more rapid uncovering of errors in politics and science, and, at the same time, increasing their credibility.[4]

3 Regarding the concept of curation, also consider the discussion at the project blog: Schmidt 2016.

4 With regard to science, blogs like "RetractionWatch" or "Pubpeer" are of note.

By now the euphoria with respect to Social Media has given way to a certain disillusionment, which arrived with the experience of dysfunctional forms of communication (hate speech, misinformation, formation of closed networks etc.).[5]

This is supplemented by another ambivalent aspect: While the model of representative democracy in conjunction with the role of a journalistic media, being as independent as possible (and functioning as a "fourth estate"), has until now guaranteed unchallenged political stability in the industrialised nations of the west, digitisation and the accompanying spread of Social Media has led to fierce competition for attention between different media, especially between classic journalistic media and Social Media. Furthermore, Social Media allows for exchanges between individuals, groups, and larger communities. The style of notification, information and communication connected to them becomes a topic for society, as it also promotes demands for more direct democracy and participation. However, the populism increasingly common to the US and Europe and the observable loss of trust in political and intellectual elites are, though empirical evidence is still lacking, at least partially ascribed to Social Media making it easier to dismount politicians, journalists, and experts. The first voices are already warning of the danger of developments for direct democracy reversing, and moving into the opposite direction.[6]

This ambivalent assessment of Social Media is also valid for their function for science communication (see box on page 20 f.). For inner-scientific communication, the use of Social Media is already quite differentiated. Different platforms (those especially established for scientists like for example ResearchGate, Academia.edu, or Mendeley, as well as general ones like blogs, Twitter, Facebook etc.) take on different functions for scientists and are frequented quite differently.[7] Such differences can also be found between different disciplines and with regard to different topics. Core function of such platforms specifically established for scientists are, besides the increased attention within the scientific community (translated into numerical indicators), the establishing of contacts, the exchange of data and literature, and discussion of research projects and results. Thus, these platforms enable an extension and acceleration of previously occurring customary communication.

External science communication faces a slightly different situation. On the one hand, Social Media promises to inform the public about new scientific developments directly, nearly immediately and unfiltered, allowing for direct feedback, questions, and critique of science by the public. Using this media, individual scientists, as well as scientific institutions, can conceivably reach publics[8] which were previously inaccessible to conventional science communication (for example through exhibitions, or scientific museums). Individual persons or groups can articulate their reactions to and expectations of science, and even contribute to science in a way never before possible – at least not with a comparable potential reach. This is sometimes understood to constitute a democratisation of science, or at least a potential establishment of dialogue between science and the public. On the other hand, Social Media, with a speed and scope previously unheard of, allows for the dissemination of trivial or false information and the mobilisation of hate campaigns to discredit specific opin-

5 Representative for this shift of opinion in the community itself, cf. the comment of the previously vehement proponent of Social Media, Sascha Lobo: Lobo 2016; cf. Also Brossard/Scheufele 2013b.

6 Cf Sullivan 2016; Thiel 2016; Helbing et al. 2016, 50–58.

7 Cf. van Noorden 2014; Pscheida et al. 2014.

8 Regarding the definition of different public spheres in the context of Social Media, also see the expert opinion of Jan-Hinrik-Schmidt for the working group: Schmidt 2017, 21 ff.

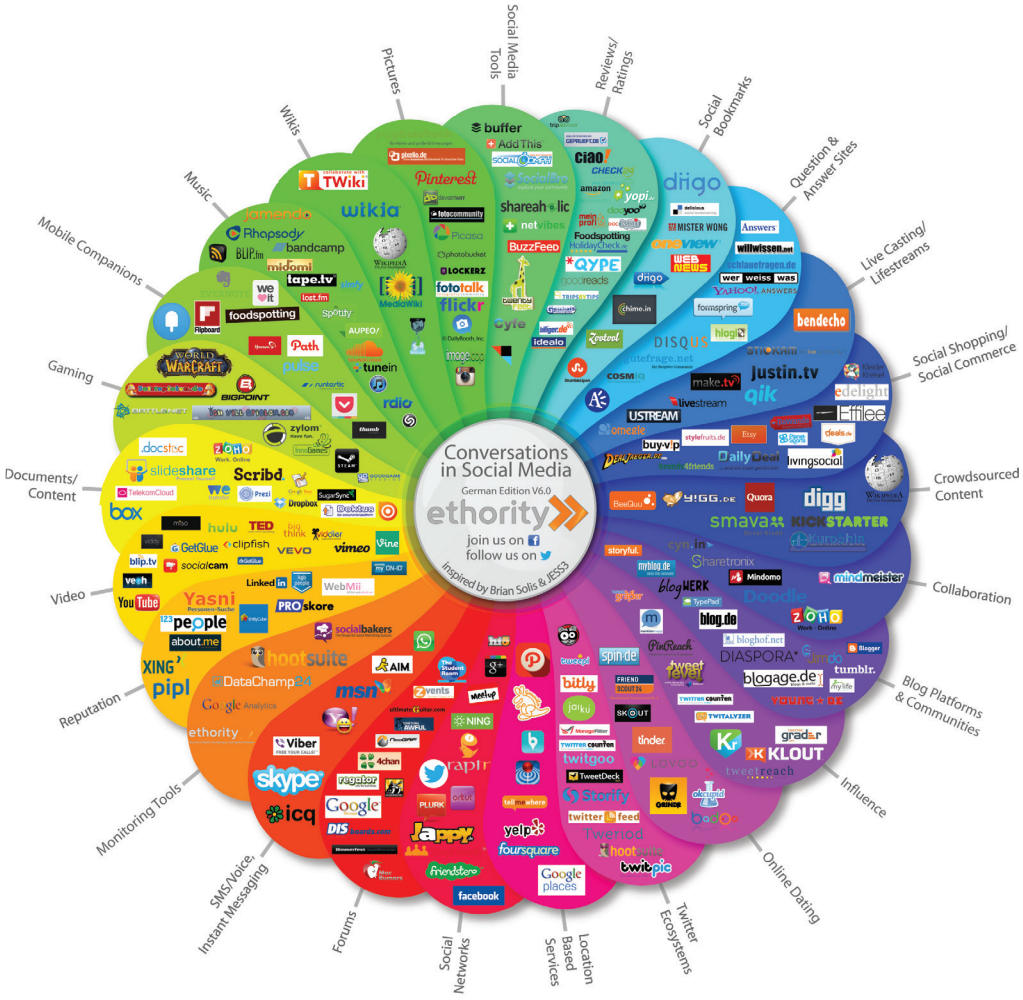

Figure 1: Diversity and Structure of Social Media (without respect to relative importance), (source: ethority 2016).

ions or unwelcome positions in political controversies. [9] Forms of "pseudoscience" hardly recognisable as such by laypersons, which previously were often screened out by gatekeepers in journalistic quality media, has initially the same general reach as any reputable scientific information. The World Economic Forum already added misinformation through Social Media to their list of the most important threats to human society.[10] While misinformation can be curated or corrected by a knowledgeable community afterwards, and the quality of already disseminated information thus be improved – it remains open how such corrections are disseminated and noticed in comparison to the original misinformation.[11]

Social Media thus deserves special attention for its specific potency in general communication in a society. This applies even more to their effects on science communication, due to its special function as interface between science and the public for disseminating reliable knowledge and as a forum for its critical reflection.

For this reason, the first working group of the academies on communication between science, public, and media decided a separate look at the wide the-

9 Here also the statement of a blogger regarding the (possible) development of science blogs: Stirn 2010. Beyond science the investigations of the public prosecutor's office in Munich against Facebook due to suspicion regarding "Beihilfe zur Volksverhetzung" [aiding and abetting sedition] should be noted (for example Fleischhauer 2016).

10 Cf. World Economic Forum 2013; Del Vicario et al. 2015.

11 Cf. for example Lewandowsky 2012; Wormer 2017a [i. E.].

matic complex of Social Media (see Figure 1) was needed.[12] At the same time, the present paper directly ties in with the recommendations on "designing communication between science, public, and the media" published in June 2014. The developments of science, journalism, and society illustrated therein remain largely valid as a framework for the specific assessment of Social Media, brought up to date in important respects. In the spirit of sustainability, taking stock of the recommendations made at the time should thus be a first step.

2.2 The 2014 Academy Recommendations and Subsequent Events

With regard to the recommendations made in 2014 (see box for short version), some have been implemented by the addressed actors by now, others have at least partially influenced existing processes – with causality being evident in some cases, while in other cases developments may have happened independently from these recommendations. However, in the meantime, many of the problems demonstrated in 2014 have further intensified, which makes the urgent need for action even more acute for a number of recommendations.[13] This is true, for example, for the funding crisis in (science) journalism and quality journalism in general. A number of science departments in print and online journalism have been consolidated with other editorial entities, or even wound up. And especially public broadcasting, which the recommendations[14] explicitly called upon to expand its commitment to the fields of information and science, in the summer of 2015 announced to retire its only current science programme in television, which was met with fierce reactions in some parts.[15]

Furthermore, quality journalism itself has come under pressure. The loudly proclaimed accusations of the "lying press" in the context of the Pegida protests, but also statements from active journalists make closer research into public support of and thus credibility of the media in the population ever more urgent.[16] It may well be assumed that criticism has simply become louder and more vehement in the age of the internet. Sometimes journalism is alleged to have a credibility problem by critics aiming to damage it. The long-term studies evaluated were unable to verify such a loss in credibility up to 2016.[17] Other studies present conflicting results, are only partially independent, or, being single surveys, are unable to show trends.[18] There is further evidence for clear differences in credibility among different services. An Emnid survey commissioned by Bayerischer Rundfunk showed rather high measures for credibility, for example 75 percent for public broadcasting and 73 percent for daily newspapers.[19] At the same time, journalists, in private conversations, repeatedly voiced their impression of a dramatic increase in accusations in the course of 2016, which published surveys may not have been able to detect

12 Cf. acatech et al. 2014.

13 On the implementation of particular recommendations of 2014 until now, see page 53 ff.

14 Among others recommendation 13 (2014): „The public broadcasters are urged to significantly strengthen their information mandate vis-a-vis their entertainment mandate in their editorial content once more."

15 Cf. for example www.keine-nische.de; regarding circulation numbers of daily newspapers and special interest magazines in the field of science journalism, see tables on page 58.

16 Cf. Medium Magazin 11/2015.

17 Cf. Reinemann/Fawzi 2016; Reinemann 2016 and Jackob et al. 2017 (cf. also Spiewak 2017 in DIE ZEIT).

18 According to a survey by Infratest, Germans themselves have a rather positive opinion of German media, but at the same time many recognise a generally decreased trust in media (infratest dimap 2016; cf. Regarding newer trends also Meedia Redaktion 2016). The Allensbach Berufsprestige-Skala (Institut für Demoskopie Allensbach)2013 also show journalism and politics losing reputation for some time now. There are increasing signs of decreasing trust in science (and other experts) as well.

19 Cf. Haas 2016. Beyond the changing framework, press and journalism are partially responsible for their credibility losses and have to face new developments with more self-criticism; cf. Jarren 2016.

yet. A generalised inquiry into the credibility of "the" media or journalism "as such" is methodologically questionable anyway. The answers seem to vary wildly – based on how the question is asked.

However, the problem of media credibility (as of the credibility of social institutions and experts in general) has greater depth than is assumed by the surveys mentioned.[20] Beyond the question, why and with regard to which functions credibility of (and trust in) the media is important, the question of whether a generalised maximum demand or, respectively, an idealised picture of media credibility can be determined: International comparative studies show credi-

From the position paper
On Designing Communication between the Scientific Community, the Public and the Media (June 2014) (acatech et al. (Eds.) 2014)

Recommendations of the working group of the academies

"Science and journalism are among the essential pillars of a democratic society. Despite their necessary independence from one another and their often divergent purposes, each also fulfils a similar function in supplying policy-makers and society with a diverse array of information that is as reliable as possible, reinforcing the education and knowledge of the population and stimulating democratic discourse. They should also provide a basis for reasoned political, economic and technological decisions. The academies responsible for this position paper are therefore concerned about some of the current developments in the scientific community and the media, and consider it urgently necessary that scientists and journalists themselves, as well as political decision-makers and society, take a more active role in ensuring the future quality of generally accessible information, including scientific knowledge and its representation in the media. In order to counter these undesirable developments and to improve communication among the scientific community, the public and the media in a democratic society, the academies have the following recommendations:"

Recommendations for the scientific community

1. The central committees and administrative levels of all scientific facilities should review their communication strategies with respect to compliance with scientific quality standards and scientific integrity. They should develop ethical principles and quality criteria in collaboration with journalists that will address how to communicate the results of their research to the general public and the mass media.
2. We recommend that science organisations introduce an overarching quality label to indicate trustworthy science communication so as to single out communication to the press that meets the listed criteria.
3. The principle of research integrity and self-criticism by individual scientists should obtain validity and be reinforced in communication with the public and the media. For example, the media's deliberate exaggeration of research results that are not backed up by data or evidence (hype) should be considered a violation of good scientific practice and sanctioned accordingly.
4. Universities and research facilities must focus on their internal performance metrics so that they do not prompt or reward conduct that violates the principles of truthful communication.

20 Cf. Kohring 2004; Blöbaum 2016.

Recommendations for policy-makers and social agents

5. Policy-makers are encouraged to create incentives for university administrators and for the administrators of other research institutions in order to promote integrity in communication (see Recommendations 1. to 4.).
6. The German government and political parties should pay more attention on the whole to ensuring high-quality, independent journalism at both the regional and national levels, and should promote research into the future and funding of high-quality journalism. Representatives from the media must also be included when formulating preferences for future research into this set of issues.
7. We challenge foundations in Germany to look into increasing their future commitment to the sustainable promotion of high-quality journalism.
8. In schools and teacher training, the rules and mechanics of the process of scientific discovery must be conveyed more strongly.

Recommendations for the media

9. Publishers, broadcasters, publishing associations, educational facilities and (science) journalists' professional associations are strongly urged to provide funding support to promote the development of quality criteria for reporting on topics in science. In particular, there must be more reinforcement of systematic and continuous training for journalists that will ensure again journalistic quality in all media. It must be apparent to outsiders as well and be required of public-service broadcasters in particular.
10. We recommend that a Science Press Council be established in the mould of the German Press Council (Deutscher Presserat) to assess complaints about unfair and negligent reporting, develop appropriate codes of conduct and censure glaring mistakes.
11. We advocate the establishment of a Science Media Centre in Germany that would support scientific reporting and is currently under debate, on the condition that institutionally such a facility is permanently located with journalism.
12. The mass media, publishing associations and comparable institutions are encouraged to develop common strategies on communicating the role and significance of independent journalism in a democracy. In particular, new funding models should be developed for independent and high-quality knowledge-based journalism that also include new media.
13. Public-service broadcasters are strongly urged to use their editorial content to markedly reinforce their mandate to in-form rather than entertain.

bility and trust in media to be highest in countries with restricted press freedoms and a population with a low educational level (for example in China and Indonesia), while they are the lowest in western democracies with a comparatively high degree of freedom of the press and larger educational resources (for example Sweden, Germany, or the US) already for a long time. Healthy scepticism of the population and a certain distance to governmental and political institutions and towards journalism as an institution could be seen as hallmarks of a pluralist society and a working democracy.[21] However, the measure of how much scepticism is "healthy" remains an open question.

The debate on the credibility of the media, institutions, and experts is especially pertinent to science communication. Science is the social institution most dependent on the expectation that the knowledge it produces is valid and dependable. This is a major difference

21 Cf. Müller 2013; Meier 2013.

with politics, where statements have to follow political expediency, or with business, where statements have to be convincing in the service of profit. By now, science itself is subjected to a credibility problem.[22]

The following sections will thus always look at the general developments in media (especially in Social Media) and the public spheres they constitute, in order to then map out the specific characteristics of science communication.

22 Cf. acatech et al. 2014; Wissenschaft im Dialog/TNS Emnid (2016). Here, we face the same methodological problem as in other studies on credibility, namely the response being highly dependent on how the question is phrased.

3. Analysis

In this chapter, initially the general interplay of science communication and the public in democratic societies is discussed. It outlines different forms and functions of science communication and gives a rough idea of a newly developing digital public sphere, with risks as well as opportunities, challenging classical intermediaries by new forms of communications, new actors, and new companies. Subsequently, the interplay of Social Media and science communication, the role of science communication in the context of a digital public sphere and possible feedback on the sciences themselves are investigated.

3.1 Science Communication and Society

Science communication (see box for a definition page 20 f.) in all its appearances is an element of modern societies. It, especially in the form of journalism, is generally accepted to be one of the prerequisites of democracy (see the 2014 recommendations, page 6 and page 8 ff.) This fundamental importance arises from the role of science as an ideally neutral observer and to ensure the appropriateness of complex political decisions requiring evidence. At the same time, the competent participation of the public through reflected consent or reflected objections has to be guaranteed by appropriate access to information on and the possibilities of corresponding participation in science. The latter is the function of science communication.

The continuously increasing significance of science communication over the past two decades is a sign for the more difficult conditions to maintain legitimacy that apply to science, but also to politics in general.[23] For a long time, the principle of representation was understood as a middle ground between legitimacy through election on the one hand, and the possibility of appropriate decisions through proven expert knowledge on the other hand. Science communication thus played a key role in the formation of political will and decision-making processes of representative democracy, resting on the principle of making complex political decisions not through short-term, sometimes emotional plebiscites, but detailed parliamentary deliberations. These decision-making processes allow for mobilisation and integration of the relevant and available scientific evidence, which can then become part of the search for the political compromise between interests. To support the legitimacy of decisions made in this way, apart from the professionalism of representatives and their advisers, a widespread understanding of how science achieves its results and which uncertainties and risks are associated with its methods and results is required by the public.

23 On the history of science communication cf. for example Schäfer 2015.

Definition and taxonomy of science communication

In a broader sense, science communication encompasses all forms of communication by and about the sciences, within science (professional audience) as well as in the science-external public sphere (general audience).

For a long time, **internal science communication** has been characterised by scientific actors and institutions keeping to themselves. The results of the research process (ideally after review procedures) are presented and discussed by the professional audience – for example in scientific journals or on congresses. In this, scientists are authors, publishers, reviewers, as well as recipients and participants in the discourse. An essential function of the professional audience as part of the system of science is publication and collective examination of scientific results.

External science communication traditionally describes the (multi-directional) exchange between the sciences and a broad audience from other subsystems (among them politics, business, authorities, NGOs, and media). The actors communicating about or from science are not just scientists ("Communication of Science") but also specialists and non-specialists from the other subsystems.[24] Scientists and scientific institutions are supported in their external science communication (increasingly so since the middle of the 1990s) by internal public relations departments.

Science communication is often further systematised with regard to the function or target of the communication in question. This includes communication by individuals (for example scientists, teachers, journalists) and institutions (museums, science centres, educational television, etc.) primarily geared at enlightening and educating, but also communication by individual scientists and scientific institutions (for example universities, research institutions) primarily interested in legitimisation, in extreme cases persuasive (marketing) communication. In individual cases the boundaries may be blurred. Museums and science centres, for example, can, beyond their educational goals, pursue the primary goal of positively influencing the relationship of visitors to the respective object (for example history, art, MINT subjects).

Another common differentiation marker for different forms of science communication is the distinction between self-mediated and other-mediated science communication. Ideally, the other-mediated science communication is performed by (science) journalists in traditional mass media, who take on a role of not just mediating and educating actors, but also (and especially) as commentators and gatekeepers critically questioning and examining science from the outside. In this function, journalistic media are substantially responsible for deciding which topics and opinions are broadly published. Major works thus emphasise that, from the perspective of journalism theory, not even "good science PR" can be functionally equated with science journalism, and such an equation should be interpreted as an "attempt at de-differentiating the social subsystems of science and journalism".[25] The specific function of science journalism is thus the "observation of the interdependence relation of science and society".[26] However, other actors can at least be partially categorised with other-mediated science communication – for example a museum investigates the current state of research on

24 For the case of the stem cell debate cf. Nisbet et al. 2003.
25 Kohring 2005, 118.
26 Ibid., 283.

a topic, embeds it into a social context, and conveys it in an exhibition, which is not the result of its own research. Essential elements of the traditional classification are summarised in the following graphic:

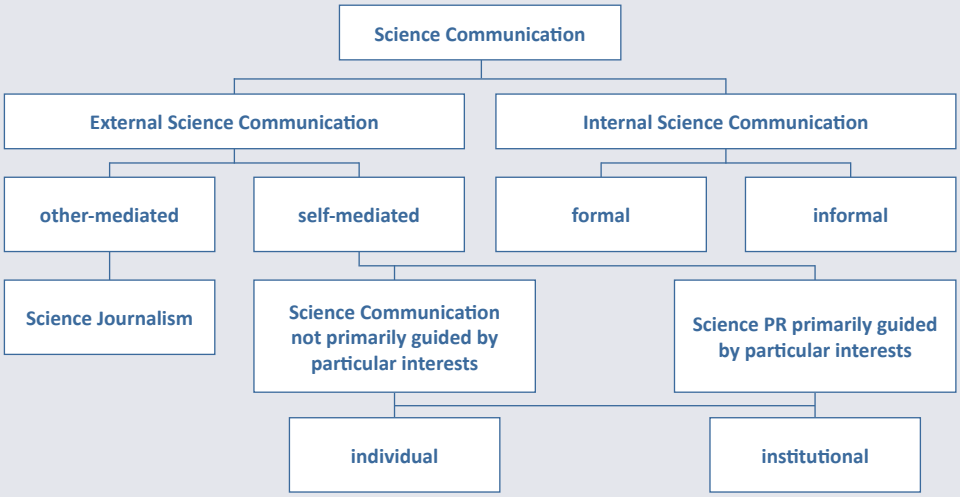

Figure 2: Traditional Taxonomy of Science Communication (Source: Beck/Dogruel 2016, 18)[27]

This institutional order is significantly changing due to the transformation of media and public sphere caused by digitisation (see chapter 3.2). For the (previously) internal science communication, open access journals, as well as sharing and exchange platforms, and preprint publication platforms like arxiv.org should be mentioned. Additionally, the boundaries between professional and general audience are blurring. Former gatekeepers can be partially bypassed. Generally speaking, the internet and Social Media present new possibilities of dissemination with (at least potentially) broad reach, which is equally open to all actors (as well as citizens interested in participation). On a single platform, for example a blog portal, journalists, scientists, PR people, and interested laypersons can communicate with each other, without their respective role (educating, enlightening, persuading) becoming visible. At the same time, there is increasing discussion on including external activities of science communication in inner-scientific performance measurement. Thus, we can speak of a convergence of different forms of science communication in multiple respects.

Note: *Against the background of different forms of science communication converging, and in contrast to the paper presented in 2014, the working group decided to employ the broader definitions described here. However, journalists often use the term "science communication" synonymously with science PR (or institutional communication), also because of its analogy with the term "business communication". Science journalism, according to this understanding, would then not be part of science communication.*

Further Sources: Bonfadelli et al. 2016; Schäfer et al. 2015; Bauer 2007; Bauer 2013; Hagenhoff 2007; Kohring 2005; Nisbet et al. 2003; Scheufele 2014; Fischhoff/Scheufele 2013; Fischhoff/Scheufele 2014; Serong et al. 2017.

27 The schema is simplified, as further actors (for example museums), which would need to be classed as "other-mediated" or "self-mediated" on a case-by-case basis, are not covered. Political stakeholders or NGOs communicating scientific content are also not covered.

Voices from expert testimonies

Authenticity and personal connection as important criteria for credibility:

"The worst is […] the press office writing for you. You are no longer authentic. I write all my blogs and tweets personally, but let them be proofread […]. There has to be a personal connection, or it is worthless. Otherwise it is an announcement by the institution. This is valid as well, but if you want to send a personal message, it has to be authentic."

Representative of the management level of a scientific organisation

To the extent that state functions have been expanded and numerous decisions are now based on scientific expertise, the requirements of professional competence on the part of elected representatives have increased. At first, professional competence as a prerequisite for political decision-making has shifted towards civil servants in specialised departments of government. However, in the course of further development, these also reached their limits and secured their access to scientific expert knowledge by internal research institutes, ad-hoc commissions, and scientific advisory committees. The (scientific) expert has thus become an important resource of state actions and of legitimating political decisions.[28]

The specialisation of politics and its increased reliance on science has been the subject of political discourse since the middle of the last century: as "rule by experts" and – especially more recently – the growing distance between political elites and the voting public. Not least Social Media, a technology of universal communication without intermediaries, accelerated a development understood to be a transition from a society characterised by trust in institutions to one characterised by trust in so-called peer groups (constituted by Social Media).[29] In this respect, in the use of Social Media, "authenticity" and "personal connection" have been established as additional criteria for the credibility of information.[30] The same is now expected also in the field of institutional science communication (see box "Voices from expert testimonies").

The research on credibility and trust tells us that persuasive force is greatest among friends and family. This previously described phenomenon is further reinforced by Social Media and its creation of "echo chambers" and "filter bubbles" (see boxes).

Against the backdrop of this development, increasing calls for direct democracy in recent years become easier to understand.[31] As the formal education lev-

28 The latter case has becomes especially evident in the politicised controversies on science-related questions. The allegation of "rule by experts" simplifies and overestimates their actual influence on political decisions. Regarding the complex relationship of science and politics and the functions of scientific advisory board in the political system cf. Weingart/Lentsch 2015.

29 Research on the loss of trust in institutions shows no unambiguous result, but a trend: „Currently, just 19% say they can trust the government always or most of the time, among the lowest levels in the past half-century" (Pew Research Center 2015, 4); see also: „A yawning trust gap is emerging between elite and mass populations. […] However, in the ‚mass population' (the remaining 85 percent of our sample), trust levels have barely budged since the Great Recession" (Edelman 2016). Regarding the thesis of the shift in trust, which is based on these surveys, cf. Tett 2016; Twenge et al. 2014.

30 Cf. Betsch et al. 2010; Gross 2009. With regard to the example of health-related information, Gigerenzer et al. (2009) assert in an analysis of nine European countries, that mass media as a source used "sometimes" or "often" are mentioned far less than family and friends; nearly two-thirds of those surveyed named family and friends, only about every second person named television.

31 Cf. for example Decker et al. 2013, p. 60: „The relatively low interest in using plebiscitary procedures is astonishing, when compared with the high esteem of direct democracy in the population. […] The call for more procedures of direct democracy is part of a general trend, which, in similar form, can be found in other European countries as well".

Echo Chamber

The metaphor of the echo chamber references the phenomenon of the creation of social networks, as well as the reception, dissemination, and evaluation of information in such networks being influenced by the specific views and opinions of their members and other participants. Therefore, undesirable opinions and different information may be no longer perceived. The permanent echo of one's own perspectives by like-minded people can strengthen such perspectives and possibly lead them to be (mis-)interpreted as a majority opinion. There is thus a risk of echo chambers counteracting the exchange of opinions and the diversity of opinion in democratic public spheres and furthering an opposing or even hostile attitude towards (scientific) experts. The increased use of Social Media and the algorithmic filtering of online information (filter bubble) can intensify and accelerate the effects of echo chambers. In the worst case, this can lead to a "digital spiral of silence" (Schweigespirale) and promote radical behaviours and attitudes damaging to democracy. A spiral of silence is most apparent in cases where echo chambers forming loud opinion camps are misinterpreted as majority opinions, leading to the actual majority to hold back.[32] Furthermore, the willingness to discuss on Social Media (especially in the case of opposing opinions) seems to be lower than in direct personal conversations anyway.[33] However, there are few empirical studies on the functions and effects of echo chambers, so an assessment based on evidence is complicated. Studies have so far identified ambivalent effects, simultaneously increased polarisation and diversity of opinion, depending on the reception by users and their existing (political) opinion.[34] Additionally, most studies are restricted to the US with their two-party system and thus only partially applicable to multi-party systems.

Further Sources: Flaxman et al. 2016; Garrett 2009; Bright 2016; Lobin 2017; Schmidt 2017; Zuiderveen Borgesius et al. 2016

el and ability to participate in expert discourses in knowledge societies becomes a prerequisite for participation, this also – especially on the side of those without it – comes to be an object of critique. In this the scientific expert becomes an object of mistrust. Therefore, the importance of science communication increases to the same extent as experts and political elites are mistrusted: As educating the public, to generate trust in decisions and the measures which are their necessary prerequisites through competent, active commitment.

The perceived loss of trust in science[35] in general and experts in particular is thus one of the major reasons for strengthening self-mediated science communication by government and science organisations since the end of the 1990s. Another reason is the politically relevant scale of public and private funding invested into research. Since then, the style of science communication, albeit primarily at the level of political rhetoric, has changed. While initially the model of "Public Understanding of Science", still wedded to traditional unidirectional mass communication, was promoted, this has shifted towards

32 On the example of vaccination debates cf. McKeever et al. 2016.

33 Cf. Hampton et al. 2014: Survey with 1'801 participants on the example of the Edward Snowden case.

34 Cf. Flaxman et al. 2016; Zuiderveen Borgesius et al. 2016.

35 Cf. also p. 13. The loss of trust in expert and science differs from topic to topic. Furthermore, the perception of this loss of trust in the public and media discourses differs from the perception created by surveys (cf. Contributions of Hampel and Renn, Merten and Peters in Hampel & Renn 1999). On the most recent findings on trust in science cf. Wissenschaftsbarometer 2016; Charisius 2016; National Science Board 2016.

Filter Bubble

The term "filter bubble", popularised by Eli Pariser, is the algorithmically limited selection of information and presentation of information on internet sites and apps. This algorithmic and personalised filtering of information produces an information landscape primarily based on the interests and habits of the respective user. In contrast to other forms of selection, algorithmic filtering often happens hidden and without the user noticing it. The effects of this automated filtering and its attributed meanings on the one hand allow for quick access to information tailored to one's own needs and interest. On the other hand, there is also a danger of an affirmative, ideological world view, and, resulting from this, an insufficient confrontation with other opinions or the diversity of opinion and information in the public and in society as a whole. Beyond that, the invisibility of algorithmic filtering opens the door for manipulation of opinion (by, for example, interest groups or targeted PR). The phenomenon of the filter bubble is also important for the field of science communication. There is little empirical research on the effects of filter bubbles on public opinion; the available results thus have insufficient validity (see box on echo chambers).

Sources: Brossard/Scheufele 2013; Flaxman et al. 2016; Pariser 2011; Lobin 2017; Schmidt 2017; Zuiderveen Borgesius et al. 2016

"Science in Dialogue" or "Public Engagement with Science and Technology" geared more towards participation. Gerhard and Schäfer distinguish two "conceptions of a scientific public describable as ideal types"[36]: an (older) "science-dominated"[37] conceptual model, and one that is "socially contextualised"[38]. The primary goal of the science-dominated concept is thus to improve the image of science by increasing the scientific literacy of citizens (based on the "deficit model" by Irwin and Wynne).[39] In the socially contextualised concept, the call for a journalistic "translation" of science is transformed into an idea of "public communication about the sciences [...] not primarily serving to convey scientific statements, but promote societal engagement with science and technology"[40]. Consequently, the functions of science communication have become increasingly differentiated, reflecting the broader circle of actors claiming the concepts and activities associated with it.

From the perspective of its initiators or authors, three basic functions (motifs) of science communication can be distinguished – initially disregarding demarcation problems and overlaps:

(1) Educating and enlightening: At first, the focus was on educating the public in a broad sense, that is informing them of new developments in research and explaining theories, experiments, effects, or observations (Public Understanding of Science). The current understanding also includes information on the methods of science, on political and economic conditions of research, and its societal implications, on ethical conflicts, as well as on experimental failures or scientific misconduct, and finally on the uncertainty of results, and inner-scientific controversies. In addition, the public should be included in a dialogical exchange with science and actively participate in it (Public Engagement with Science and Technology).[41]

36 Gerhards/Schäfer 2006, 240 ff.
37 Ibid.
38 Ibid.
39 Cf. Irwin and Wynne 1996.
40 Gerhards/Schäfer 2006, 243.
41 Cf. Leshner 2003; Rowe/Frewer 2005; Jasanoff et al. 2015.

This function of science communication is partly performed by specialised books, blogs, channels like YouTube, MOOCs, museums, science cafes, science centres, science slams, open house events, lectures and discussions, as well as special exhibitions and similar formats (as long as these are not influenced by sponsors and their special interests). This standard is also met by educational projects of research institutions and their public relations departments. Journalistic reporting of mass media also plays a major role, as its own professional standards and statutes demand neutral and objective reporting, also in the case of scientific topics, but at the same time demand a dialogue with citizens.[42]

Science also criticises itself as part of the educating and enlightening function of science communication, which is then taken up by society. Technology assessment and critical questioning of scientific certainties have been transferred to roundtables and "consensus conferences", where scientists and citizens implement this principle of (self-) criticism in political decisions. Newer forms, also from the side of science, understand enlightenment increasingly as participation, active engagement, and dialogue. This is put into effect through blogs or online consultations.

(2) Legitimating: Considerable (especially institutional) efforts of science communication serve to comprehensively convey fundamentals for research and teaching, for science policy, and thereby to legitimate science and its organisations. These are meant to create public trust, general support, and interest in science. This is considered politically important and desirable, as public expenditures for research are comparatively high, while effects become visible only indirectly, abstractly, and often only over the long term.

Specific journalistic forms (for example research magazines and online presences of the respective institutions) are devoted to this function of science communication, but also (major) events, which among them count events with educational character: The science years, the nano truck, the science train, or the ship "MS Wissenschaft" and similar forms should be mentioned here. They follow the principle of edutainment, connecting education and entertainment, for reasons of general approval. However, primarily these are publicly funded public relations measures. The funding organisations (among others the Federal Ministry of Education and Research, Deutsche Forschungsgemeinschaft, VolkswagenStiftung) pursue strategies for legitimating their own activities by making communication of research results to the public (for example in the form of press work) part of the conditions for their participation.

(3) Getting attention: This function of science communication is performed mainly by scientific organisations, that is universities and research institutions, but also by individual scientists with large media presences. They pursue the goal of raising their profiles in competition for public funds (like grants by foundations and businesses, in the case of universities also for student attractiveness), which they – following the logic of advertising and marketing – hope to achieve by obtaining general public attention, which can then be translated into political support. Scientists also follow this logic by self-marketing or raising attention for themselves – which happens increasingly via Social Media.[43]

42 This control function is often denied from the side of science – with journalism being assigned the role of translation and gathering attention within a "paradigm of science popularisation" (Kohring 1997; 2005); on the critical and control function of science journalism also cf. Blattmann et al. 2014, 391–412.

43 An exception for this is the astronaut and geophysicist Alexander Gerst, who has more than 400'000 twitter followers (November 2016). However, according to a study by TU Dresden, the use of Twitter by German scientists is comparatively low (cf. for example Osel 2015), as well as the reach of individuals.

Both the educating and legitimating functions are concerned with attention. However, once there are no longer specifically defined publics and getting attention becomes and end in itself, for example when key measures are used for orientation, shifts in objectives take place. Prime examples for attention-getting becoming an end in itself are marketing brochures and in-house magazines of institutional persuasive communication, following the principles of PR, branding and marketing. While dedicated to promoting the institution, they are distributed to an unspecified public. Their effects are not evaluated.

The distinction between a science communication geared towards education and persuasive, primarily institutional science communication is relevant for the following discussion. It describes a development characterised by Volker Meyer-Guckel, Deputy General Secretary of Stifterverband and co-initiator of the German PUSH activities: "The science communication discussed in Germany is actually science marketing. Such a misunderstanding, common to many scientists and institutions, will in the long run become a problem for science."[44] In fact, the spreading of political and advertising logic to science communication can be observed. The orientation towards truth and integrity, internally binding for communication within science, is supplemented by an orientation towards the logic of politics, economics, and media: Attention counts. This has increasingly led to overlaps between education, legitimation, and attention getting.

This development is reinforced by Social Media. In the case of individual scientists directly communicating via blog or Twitter, it becomes increasingly difficult to discern whether they are primarily speaking as educating experts (in the role they would have been invited to speak by journalists) or primarily in pursuit of attention and legitimacy.

3.2 The Development of a Digital Public Sphere

The increasing use of digital media (see Diagram 1)[45] has led to fundamental transformations of the media and the public sphere. Internet and Social Media differ from traditional mass media by technological multi-optionality and socially open use: In principle, nowadays everyone can, with little effort, become a communicator and provider of public communication (on the age structure of Social Media platform users and different types of internet usage see diagrams 2 and 3). Besides the potential of the internet regarding the social dimension (participation, interaction, transparency) it also opens up the temporal dimension (permanent and speedy updates, archiving), the spatial dimension (global distribution, mobile communication), and the signal dimension (multimedia) for ever broader possibilities.

At the same time journalism "has not lost its influence for setting the agenda, even on the internet"[46]. Here, as well, it determines the important topics, which are taken up, distributed, and discussed on Social Media. The question of whether the internet can lead to a fragmentation of

44 Meyer-Guckel 2012; cf. on this recent debates like the symposium "Image statt Inhalt?" initiated by VolkswagenStiftung or Deutsche Universitätszeitung 2014, 24–37. The notion criticised by Meyer-Guckel is supported by the definition of science communication on the German Wikipedia page: "Science communication (synonymous with Science-PR) is a new field of public relations and describes the management of public communication within science" (Wikipedia 2016). This definition differs not only significantly from the English Wikipedia version, but also from an earlier German version.

45 On increasing internet usage and the data of ARD/ZDF-Onlinestudie 2015 cf. also Frees/Koch 2015. An international comparison of usage data is provided by, for example, Reuters 2016, 84 ff. According to this, Germany takes last place with 59 percent usage of online media, while Brazil takes first place with 91 percent. The results on which sources are primarily used varies accordingly (Germany: Traditional users 50 percent vs. Mainly digital users 13 percent; Greece: 16 percent vs. 35 percent).

46 Neuberger 2014, 324.

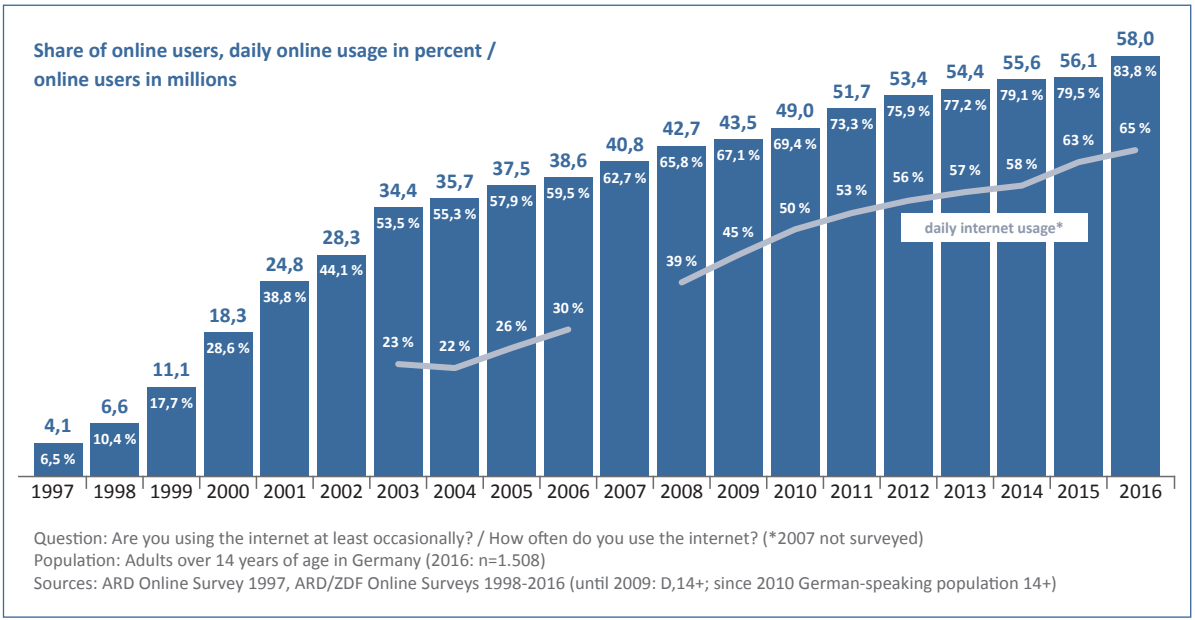

Diagram 1: Increase of internet usage in Germany 1997-2016

the public sphere is the subject of scientific debates. Previous studies were unable to provide empirical evidence for this. Further discussion is needed on the insufficiently clear results on whether opinion camps are isolating themselves from each other. The somewhat opposed assumption of the internet furthering a strict focus on consumer markets far exceeding that of traditional media, is most likely to be correct. "In this, prevention of abuse of the resulting power of opinion must be secured."[47]

While usage numbers regarding the internet as a source of information on science- and research-related topics are relatively high, there is still more trust in traditional media.[48] Of the two-thirds of the population over 14 years utilising online media for information on science and research, many trust traditional sources or professional journalistic communicators: 81 percent use websites and media centres of well-known consumer media, while only 35 percent use the websites of scientific organisations or research institutions. Social Media sources are also used less than journalistic online media for information about science: 45 percent use YouTube, 33 percent blogs and forums, and only 32 percent use social network services and microblogs (Twitter) for information.[49] In talks with representatives of the management level of scientific organisations, it became clear they still prefer traditional (print) media for information on public issues. The board members of scientific organisations are regularly informed through "relevant clippings" from these traditional media.

Nonetheless, the total numbers for internet usage in the field of science communication are relatively high. According to Science Barometer 2016, 44 percent of the 1'006 surveyed use the internet as an information source for science and research, 68 percent use television for information, 54 percent read printed (!) articles on scientific topics in newspapers and magazines.[50]

47 Neuberger 2014, 324.

48 According to the JIM-Studie 2015 (Medienpädagogischer Forschungsverbund Südwest 2015, 17 f.) this is also true for younger users. Television and daily newspapers are clearly preferred over the internet with regard to political and local topics and current events.

49 Cf. Dogruel/Beck 2017; on the reach of Social Media formats in general see table 3 in the appendix.

50 Cf. Wissenschaft im Dialog/TNS Emnid 2016.

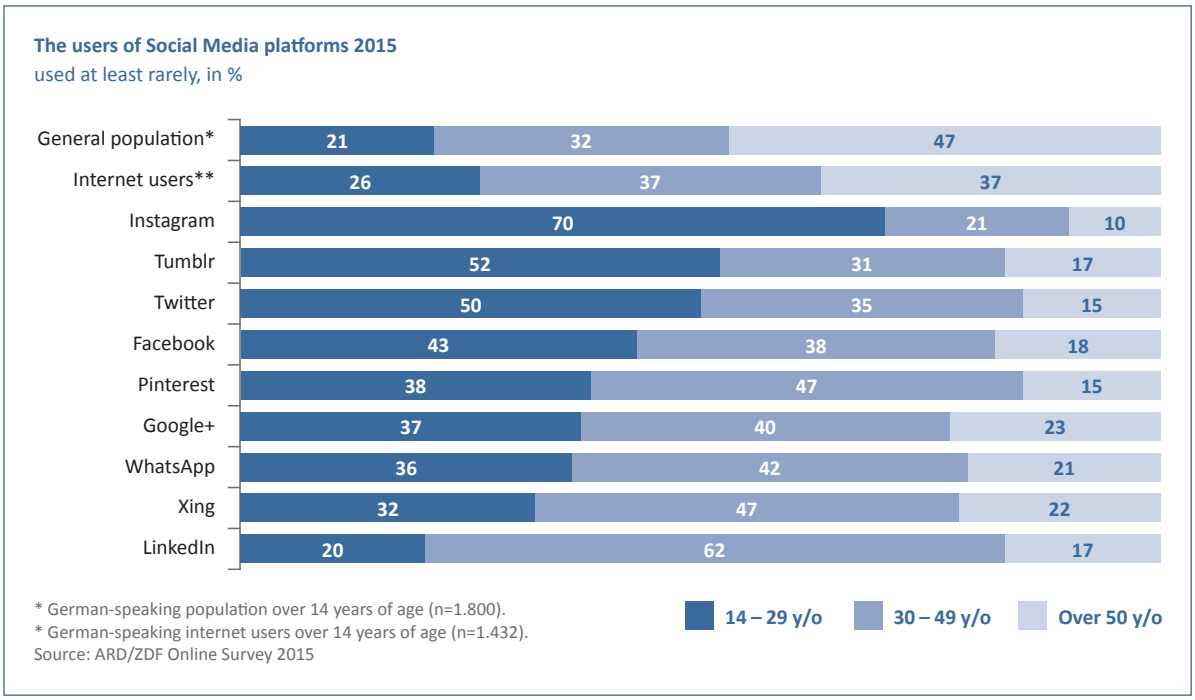

Diagram 2: Age distribution of Social Media platform users 2015 (Source: Tippelt/Kupferschmitt 2015, 445)[51]

The experiences with the internet so far tell us that the social impact cannot yet be conclusively assessed and should be seen ambivalently at the moment. Opportunities and risks are juxtaposed in both public debate and research. By measuring internet communication according to fundamental social values, the following can be said:

Freedom: The internet promises free and unimpeded access for everyone to the public sphere, while states and corporations are increasingly controlling the flow of information and the participants, for example by evaluating traces of data. Data are the business model of the in part quasi-monopolistic corporations like Google or Facebook (but also in the field of scientific publishing: for example Elsevier). Public access to this data is not provided.

Equality: On the one hand, the internet – in addition to political participation – facilitates broad and rapid access to knowledge archives. On the other hand, observable differences between population groups with regard to access, usage, and response may lead to increased social inequality (digital divide).

Integration: The internet can create a shared public space and overcome boundaries between classes, interest groups, parties, ethnicities, cultures, and nations. In a further differentiation of the public sphere, new forms of selection and observation emerge, bringing with them increased possibilities of provision, mediation, and observation. At the same time it contributes to the disintegration of the public sphere, caused both by selective attention to and separation of users according to thematic or opinion preferences (echo chambers, cf. box on page 23), but also through the personalised selection by algorithms (filter bubble, cf. box on page 24).[52] Like-minded

51 "Looking at the user structure, it becomes evident that Social Media applications are still the domain of younger users, even more so than the internet in general. While only about one-fifth of the general population, and about a quarter of internet users are between 14 and 29 years old, the share of teens and twens in Social Media services is nearly universally greater" (Tippelt/Kupferschmitt 2015, 445).

52 Cf. Lobin 2017 on algorithms in the context of scientific Social Media platforms and their differentiation into rating and suggestion algorithms.

Communication and media consumption lead in usage duration
Population: All surveyed, in percent

Usage duration yesterday	Total	Women	Men	14 – 29 year-olds	30 – 49 year-olds	50 – 69 year-olds	Over 70 year-olds
Communication on the internet	39 %	45 %	35 %	41 %	42 %	38 %	17 %
Media consumption on the internet	24 %	20 %	28 %	29 %	23 %	21 %	15 %
Research on the internet	17 %	17 %	17 %	14 %	19 %	22 %	22 %
Games on the internet	14 %	12 %	14 %	13 %	11 %	11 %	30 %
Transactions on the internet	6 %	5 %	5 %	4 %	5 %	8 %	15 %

Question: Now the focus is on what you did on the internet yesterday, and how much time you spend doing it...
Population: Adults over 14 years of age in Germany (2016: n=1.508)
Source: ARD/ZDF Online Survey 2016 (German-speaking population 14+)

Diagram 3: Internet usage in Germany 2016

"The German-speaking population spends about half an hour each day consuming **media on the internet**, representing 24 percent of their time online. Among under-30-year-olds, this rises to 86 minutes (29 percent usage time), that is about one and a half hour each day. **Communication on the internet**, that is email, chat or interacting in Social Media services, consumes 39 percent of their time online. The category of **information research** receives 24 minutes or a share of 17 percent. **Games on the internet** occupy 19 minutes (share: 14 percent), the current increase can mostly be ascribed to men and over-70-year-olds. The least time is spent with **transactions**, in the sense of looking for products, shopping online, and online banking. Additionally, one thing is true for all activities on the internet: The younger the person, the more time spent on the internet." (Source: http://www.ard-zdf-onlinestudie.de/fileadmin/Onlinestudie_2016/Kern-Ergebnisse_ARDZDF-Onlinestudie_2016.pdf, p: 5)

people separate themselves into echo chambers, reinforce their shared world view, without being accessible or receptive to outside criticism.

Quality of the discussion: The internet has the potential to improve public discourses. No other medium allows for comparable citizen mass participation in opinion-forming processes. At the same time, public discourse is observably becoming shallower and more brutal, which is connected to a lack of editorially balanced, independent moderation like that of journalists in quality media. On the internet, journalistic (and also scientific) gatekeepers can be bypassed.

Quality of information: Without obligatory assessment of information by journalistic gatekeepers prior to publication, quality control is often eliminated. Accordingly, speculative knowledge (rumours, conspiracy theories) and misinformation can spread relatively unimpeded. Campaigns for influencing public opinion are seldom thwarted by journalists on Social Media. In a best case (for example in authoritarian countries), government-critical messages can spread, however in democratic countries the same can happen to anti-democratic views. The credibility and substance of information on the internet is often hard to evaluate, especially as its amount is already over-

whelming and steadily growing. The sharing of information on Social Media makes it impossible or more difficult to identify the information source. In the most desirable case, acceleration of communication allows for rapid correction of false information, in the worst case careful examination and deeper discussions (see box "Voices from expert testimonies") are neglected. In addition to these risks, the internet also creates new forms of collaborative knowledge generation, examination, and dissemination (for example Wikipedia).

Diversity: The internet, in virtue of its openness, can show topics, opinions, and speaker in their full range. This increases the available diversity of publications. However, intermediaries, that are the providers of network platforms and search engines, acquire power of opinion, as they are influencing communicative participation and discoverability. Attention is very unevenly distributed on the internet, and most participants only get few responses ("long tail").[53] In fact, the technologically available possibilities of this new diversity are used relatively rarely.

Transparency: Context boundaries, previously hard to overcome, become porous on the internet, for example the boundaries between public and private sphere or professional and general audience. Information kept secret (for example WikiLeaks) or data that is hard to access (Open Democracy, Open Science) are becoming available. The audience thereby can receive deeper insights, for example into scientific professional knowledge. In how far the prerequisites for an appropriate understanding are present in the audience is still unknown. Transparency can also have negative effects, as (for example personality) rights may be violated or information may be secretively procured ("leaked") with the intent of manipulation. Data made publicly available can enter the commercial processes of data-based internet corporations like Google and Facebook unimpeded and thereby contribute to their business models.

This initial survey shows: The digital public sphere is a complex, dynamic system, characterised by the actions of numerous different actors, with many intentional and unintentional effects. In order to better utilise opportunities and ideally eliminate risks, an institutional order needs to be created, which can meet this challenge. The relevant regulatory requirements are still to be identified. For this, external regulation (law) and self-regulation (codes), as well as mediators in the general audience (journalism, PR) and professional audience (professional media) play their roles. Intermediaries on the internet (network platforms, search engines) are relevant for both audiences.

3.3 Displacement of the Classical Intermediaries?

Which forms and functions of traditional, *journalistic* mass media are challenged by new forms of communication, actors, and (global) corporations? The present chapter is devoted to this question, with a special focus on the institutional side of the public sphere. It discusses how new forms of communication, actors, and corporation can be related to traditional ones and in how far they (can) take over journalistic or mass media functions.

Traditional mass media, that is press, radio, and television, are still normatively and functionally relevant for communication in society. In the past 30 years, massive differentiation has taken place in this media sector (a host of new radio and television services; expanding market of (specialist) magazines etc.). In the past two decades numerous online

53 Cf. Anderson 2004.

Voices from expert testimonies

Using Social Media constructively and thereby fighting misinformation:

"One-sided statements have to be countered in the same medium. The problem is not the medium where it happens, but the lesser extent of serious science communication taking place there. Science communication increasingly has to use these [digital] media to counteract this. […] By appropriately using the media – and mechanisms – my messages are spreading rapidly."

Social Media expert

"Social Media also helps in putting all information on the table. There is a danger for incorrect information to appear as well. This is why everyone has to use the same medium"[54]

Representative of the management level of a scientific organisation

services were added, partially developed and operated by traditional media. At the same time, other organisations, groups, and individual persons created corresponding services and reached the public while moving past established media. At least a small minority of these new journalistic products (also in the field of science communication) reaches mass media dimensions: In the English-speaking world for example the popular projects "I fucking love science" by British Elise Andrew (originally founded on Facebook) or "ScienceAlert" by Australians Julian Cribb and Chris Casella, who – irrespective of their generally less profound and often tabloid-style approach – have similar reach as established journalistic media like wired.com, scientificamerican.com or newscientist.com. The majority of their hits originate from Facebook. The majority of services does not reach these dimensions. On the whole, the new services are able, for individual processes in public communication, to achieve relevance and take up media usage time. The Social Media platforms add new possibilities for self-presentation and individualised provision and use of very different information. New forms of expression[55] are also potentially suitable to familiarise people, who are hard to reach via conventional scientific journalism, with scientific topics.

Due to Social Media, the exchange between individuals and groups, as well as their self-organisation becomes easier. This has consequences for traditional mass media, which generally – and particularly with certain groups – have lost a share of their attention, with sometimes dramatic effects for their funding (advertising, subscribers). The funding problems of traditional mass media also affect journalism. Social Media platforms do not perform journalistic work in its original sense; at the same time, these platforms have becomes indispensable for journalistic media to spread their own services. Journalistic services operated by the platforms themselves are a possibility, but due to the fact that large providers position themselves as part of the advertising industry, these are to be viewed with scepticism.[56]

54 Cf. on this also an article in F.A.S. by Hillje (2016) with the subtitle "Populists win elections with the help of social networks. However, these can also be used against Trump & Co." This assessment is countered by voices calling for consistently ignoring hate speech and misinformation on the internet (if a deletion is not required for legal reasons), in order to refrain from drawing undue attention to them.

55 An analysis on the strategies used by popular English-language blogs to reach their audience is provided by Ranger/Butlitude 2016.

56 See for example the interview with Eli Pariser (Kuhn/Hauck 2012), where he points out the repudiation of journalistic responsibility on the part of Google.

At the same time, online and Social Media platforms lead to new institutional forms for the media. This also entails new rules and norms for both private and public communication. There is thus a transformation of the whole social order of information and communication, primarily influenced by new actors with specific forms of mediation and services, as well as by new possibilities of participation, observation, and usage on the side of recipients or users. This change also feeds back to traditional mass media. The vastly improved technological abilities for mediation led to a large increase in the volume of information supply, no longer filtered through the bottlenecks of traditional media. In addition to mediation by the mass media, messages for individuals, groups, or everyone are increasingly produced and disseminated by online media. In addition to the information selected by known and generally accepted professional journalistic standards, or at least judged to be relevant[57] (or worthy of communication) by those standards, there are messages which only become relevant by forwarding them to individuals or groups, because they are shared.

A large part of information provision and information exchange now takes place at the time and place of (the user's) choosing. This also has consequences for all forms of science communication. The sharing of selected content becomes itself an attribution of meaning. Evaluation, response, echo (cf. box echo chamber on page 23) become new features of meaning. The question of whom to attribute this performance comes into view: The producer of the message or the forwarder? Assigning relevance and certifying information, for a long time the responsibility of professional actors, specifically journalists, is now performed by other actors as well.[58] What is shared together is no longer created and presented just by traditional media alone, but can also be offered by individuals or groups. Additionally, the recipients can now evaluate messages from all channels and very different senders, which is what makes them relevant in the first place. Relevance is no longer determined solely by the producer of the message, but also by mediators and those who share it – which is complicated even further by interest-driven mediators and sharers possibly not being persons, but social bots with an agenda. The new technological possibilities harbour the threat of invisible manipulation of discourses. Despite the growing number of Social Media platforms, the journalism of traditional mass media continues to represent the largest part of thematically relevant contributions for public communication (and follow-up communication on Social Media), due to both its journalistic range and volume.

The aim of the mass media to reach and integrate as many people as possible leads to a targeted inclusion of the audience. This inclusion or integration becomes increasingly important in socially, economically, and culturally differentiated societies. This will be even more true when further possibilities of individualised information and communication, as with Social Media, open up for individuals and groups. However, journalism has not been established in Social Media platforms – beyond distribution of classical media content. While these platforms undoubtedly increase the possibilities of individual information and communication, and individual possibilities for expression, a secure, reliable provision of selection services is rare.

57 The concept of relevance is primarily used in the meaning of "worthy of communication" here. Strictly speaking, according to traditional journalistic standards, the concept of relevance is only one of several factors of the selection of news, among topicality, proximity, but also originality and entertainment or surprise.

58 However, since the 1980s, research on reception and acquisition (cf. The classic study "Watching Dallas" by Ien Ang) has shown that media content and its subsequent treatment in media reception follows an inner logic. Still, Social Media creates a massive expansion and diversification of such possibilities of treatment according to this inner logic.

But reliable information is increasingly called for as the supply of messages on all channels is already overwhelming and growing steadily. The journalism of the mass media, with its established forms of collective gathering of information and professional selection processes, performs an essential contribution for quality control in the fields of information and communication. These services are provided by mass media by means of setting topics for the general societal agenda and socially necessary co-orientation.[59] Society is dependent on these for safe action, both in public and in private affairs. Nobody has to follow the agenda set by the media, but all members of society have to know with a high degree of reliability what is happening – in order to decide for themselves (possibly otherwise). Mass media, reporting correctly and as independently as possible, are thus not just normatively but also functionally crucial for modern, differentiated, democratic societies. However, they are now being challenged by the big internet corporations – the providers of search engines and Social Media.

Dramatic changes in the field of traditional mass media are endangering the reliability of journalistic media communication, as well as the trust placed in them. Growing sales pressure and decreasing financial and personal resources unsurprisingly lead to increased violation of journalistic professional standards and professional norms of media ethics; some of the previously most important actors in social communication are threatened. These connections are not just valid for the mass media in general, but also for journalistically responsible science communication. Parallels with the quality control problems of inner-scientific communication caused by digitisation are becoming apparent. With respect to science journalism, this is primarily true for its role as a neutral observer, allowing recipients first of all to form an opinion for themselves, on the basis of a neutral presentation. If this intermediary function is lost on the internet, recipients are unable to distinguish between primarily interest-driven and independent presentation, between fact and mere opinions. In the digital public sphere, the boundaries between journalism and PR are blurring[60], just like those between sound reporting and the propagation of opinion or even disinformation.

In the meantime, the problem of quality control of internet communication has been recognised by individual actors, who (at least partially) try to create functional equivalents for traditional intermediaries. An example is the platform "The Conversation" (https://theconversation.com)[61] which was founded in Australia, but operates in multiple countries. In the face of science journalism being mostly abandoned there, scientific institutions cooperated to fill this gap. Using the motto "Academic Rigour, Journalistic Flair", they offer news and opinion from the sciences. Authors or sources are generally scientists from the participating institutions, supported by editorial staff. Although the project is unable to replace external observation of the science system (for example by journalistic media), the fact of participation by scientists and communicators from different research institutions should guarantee some independence and compliance with standards. In principle, the response (for example in Social Media) to the contributions of individual scientists and their research results can even be incorporated to scientific performance measures (although this raises the problem of false incentives, see box on altmetrics on page 40). Fur-

59 Cf. Altmeppen 2006. Journalism not measuring up to the mentioned requirements should be seen as violating professional standards; however, this does not alter the assignment of functions taking place here.

60 Cf. on the relation of journalism and PR: Riesmeyer 2014; Ruß-Mohl 2015.

61 Cf. on this also Bruns 2017.

ther examples are the platform "Causa" (https://causa.tagesspiegel.de)[62] or the "Interaction Support Processor" (https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2015118455). These are an attempt to create possibilities for quality control by bringing together experts from different subjects on a single topic (as in the debate portal "Causa") and of mutual evaluation of trustworthiness (as in the "Interaction Support Processor"). Through this, a mechanism similar to classical "peer review" in science can be simulated: The authors accumulate reputation through recipients approving their communication, which creates trustworthiness for further communication. It is still open, how far such algorithms and platforms can establish themselves in the field of science communication. The possibility of a close coupling between inner-scientific and science-external feedback causing further medialisation of science (see also chapter 3.5) should be kept in mind.

3.4 Science Communication and Social Media

Social Media has long taken hold of science communication. Their use ranges from scientists communicating with each other to institutional communication of scientific institutions of every kind. The field of science journalism as well seems hard to imagine without Social Media and other forms of communication made possible by digitisation.[63] Users can convey their own journalistic products, but Social Media is primarily used for research and for guiding users to self-produced journalistic content on the internet (social traffic). In the meantime, the job profile of Social Media editor has developed. Further actors, beyond the groups of scientists, journalists, or workers in public relations, are voicing their opinion on scientific topics via blog or video, and thus perform science communication according to the broader definition employed here. The diversity of format, wildly diverging with respect to function and effect in science communication, at present does not allow for a uniform assessment of the impact of these media on science communication.[64] In general, the literature distinguishes between three formats: Platforms (network and UGC platforms, among others Facebook), personal publishing (blogs and microblogs, for example Twitter) and wikis (primarily Wikipedia) (see also figure 2). The performance of these formats differs both with respect to sending information as well as to reception and to the user groups that are addressed. For each form of media – irrespective of the different functionality – the use of Social Media in science communication carries with it different opportunities and risks (or problem areas), which is why their evaluation turns out to be ambivalent (see box "Voices from expert testimonies").

The following opportunities can be identified:

- Social Media opens up opportunities for directly addressing specific social groups. This is especially true for young people, who are less and less oriented towards traditional mass media (newspaper, radio, television).[65]
- New formats develop, which may have a positive effect on the diversity of

62 Cf. also the talk by Anna Sauerbrey (Sauerbrey 2016). However, the take-up of the Causa debate service seems to be very low, according to the data on the website.

63 For more innovative forms of science reporting see, for example, "Substanz" magazine (www.substanzmagazin.de), which promised, from its beginnings in November 2014, to be the first magazine to cover each story with a digital mindset, and use all the techniques provided by the computer to best present these "stories from the heart of science". However, already in the middle of 2015 this new magazine faced financial difficulties.

64 Cf. On this the circulation numbers of popular science magazines in the appendix and data from ARD/ZDF 2015 and analyses like Kroll 2015.

65 Cf. Nationlal Science Board 2016: "Different subgroups of Americans tend to rely on different sources of information. Generally, higher levels of education and income are associated with relatively higher levels of Internet and newspaper use, whereas respondents with lower levels of education and income are more likely to say they rely on television. Newspaper reliance is more common for relatively older respondents, and Internet reliance is more common for relatively younger and higher-earning respondents."

forms in established media, which partially adapt trends from Social Media and develop them further.[66]
- Communication is more direct and often quicker than with traditional media. The more personal and possibly more emotional approach (for example in popular blogs) offers the potential for reporting "closer" to the everyday life of the users.
- At least in some forms of Social Media, communication is more reciprocal, which requires prompt and appropriate responses.
- Due to the rather informal character of communication and the potential participation of all citizens a new culture of debate could be developed.
- While there are doubts as to the assumption of a broader democratisation in the context of Social Media (especially if the goal is sophisticated and professional dialogue), at least expert dialogues may be expanded to expert-layperson-dialogues.
- Social Media opens up possibilities, for example of science quickly reacting to faulty reporting with corrections, but also for pointing out errors in scientific publications.[67]

These opportunities are contrasted with risks:
- Journalism and traditional mass media are institutions designed to be as independent as possible. Mass media messages thus are of great importance for science communication as well. While they still enjoy a great amount of trust, this is threatened in recent times. One sign is the sometimes targeted discrediting (Keyword "lying press", see also chapter 2.2). Social Media can possibly aggravate this tendency, but above all they exacerbate the funding crisis in parts of independent journalism – risking a "monopolistic shift in the market".[68]
- Especially the large Social Media providers like Facebook provide content according to opaque technological rules, which, in the case of some messages, can lead to a credibility problem even for those publishing content there.
- For democratically relevant communication, not only the provision of messages, which Social Media platforms primarily provide, but also the constructive exchange about these messages to achieve formation of opinion and political will. This requires processing messages (selection) and their classification (for example commenting) or professional moderation.
- Participating in media without specific selection criteria requires special communicative knowledge and skills on the part of scientists, which many may not possess.
- The impact of communicated content can instantly be devalued by comments, which often is hard to correct – the possibility of a debate slipping into a shitstorm is always present.
- Chatbots (social bots; see box) with particular interests can dominate debates and give completely misleading impressions on the state of the debate.[69]
- The supposed freedom of publishing of private Social Media providers is not given. There is a hidden algorithmically induced control of part of the message by the platforms (for example the Facebook newsfeed or the Twitter timeline).

66 Of course, internal communication between professional scientists can also take place on Social Media platforms. In a discussion on a blog entry by Henning Lobin on the project blog "Wissenschaftskommunikation³" of the working group, a discussion of professional astronomers regarding the "Big Bang Echo" (BICEP2 project) in a Facebook group was mentioned as an example.

67 See the platform RetractionWatch (http://retractionwatch.com/).

68 Lobigs 2016, 27. Already there, he speaks of "unassailable, monopolistic market advantages" of the respective providers and of an "increasingly also politically monopolistic shift of power".

69 Against the background of the US elections and the intensified discussion about "Fake News", in Süddeutsche Zeitung Evelyn Roll (2016) even demanded a ban of social bots, especially in election campaigns; cf. on the legal discussion about an "algorithmic police" also Lobe 2016.

Voices from expert testimonies

Ambivalent evaluation of using Social Media for science communication

Social Media is good for conveying emotions and for influencing public opinion – in both a positive and a negative sense:

"Previously, I saw Twitter as an absurdity, as it was too abridged. […] [However,] with this short Twitter message he really created an atmosphere. […] I can distribute this atmosphere via such media and do not have to wait until a newspaper criticises this in some way. I can act proactively, which is why I would always want to use these tools."

Representative of the management level of a scientific organisation

Example for the creation or (culturally-specific) amplification of negative attitudes on specific technologies with effects on their funding and research.

"Also under the influence of Social Media, the image of the 'burning water tap' was spread, which one-sidedly influenced general opinion with regard to this technology, making an unbiased discussion in Germany impossible."

Representative of the management level of a scientific organisation

- The impact of private providers influencing Social Media by algorithms may lead to "echo chambers" – resulting in the potential democratising effect being undermined and even in the creation of a counteracting effect: Communication is structured according to certain opinions, fruitful controversies are generally avoided.
- Due to the low threshold for access to Social Media platforms it becomes easier for emotional communication (among others hate speech) and (intentionally or unintentionally) for misinformation to spread virally. While these can be seen as undesirable developments of Social Media in general, they may also lead to problems of credibility and trust for all participants. This is a particular risk for actors participating in science communication.[70]

Against this background, the traditional distribution channels still remain relevant for institutions and actors from science. In addition to knowledge transfer and self-presentation, Social Media opens up new possibilities for developing and testing new forms of target group communication, dialogue, etc. Therefore, experiments in using Social Media providers are recommended, or alternatively, the systematic support and evaluation of existing experiments. This is the only way to evaluate whether and in which cases the gap between scientists and laypersons really has been reduced. Forms well-received by the public[71] could then be permanently established. In addition, forms for improving the responsivity between scientists and (partial) publics could be developed and tested. In general, it has become essential, not just for science, but also for journalistic media as well, to use Social Media in order to draw attention to their own information services (social traffic) – which, at the same time, leads or already has led to dependence on the large providers of Social Media platforms.[72]

70 For this reason a number of providers disabled their comments function again; cf. Ellis 2015; The Coral Project 2016; LaBarre 2013; also Anderson et al. 2014.

71 According to a report by the National Academies of Sciences, Engineering, and Medicine (2016, 4-7), non-scientists are more likely to share scientific information if they arouse emotional reactions or are useful in one's everyday life (for the respective study, cf. Milkman/Berger 2014).

72 WELT pointedly asked "Does Facebook make or break journalism?" (Praschl 2016).

Social bots (Chatbots):

The term social bot describes software robots found on different Social Media platforms and performing diverse services, based on the interests of their programmers. For example, they are co-players in virtual worlds or communication partners in chatrooms. In many cases bots simulate the accounts and profiles customary to Social Media, which is why they are not immediately identifiable as robots. In the context of (political) discourse on the internet, they can be used as automated mood-creators ("opinion robots"[73]), thereby manipulating the discourse. This (for example in contrast to advertorials or traditional advertising/propaganda) opens up a new dimension of manipulation, as users are under the impression of individual persons taking a position or recommending content, while the statements are actually produced by machines. At least 400'000 bots were active in the political discussion on the US presidential election on twitter – producing 20 percent of all thematically fitting tweets, 75 percent of those with messages positive about Trump. According to an expert report produced for the working group, about ten percent of all accounts on Twitter are operated not by humans, but by programmes (cf. Lobin 2016).

Further Sources: Howard/Kollanyi 2016; Dönges 2016; Bessi/Ferrara 2016; Lobe 2016; Lobin 2017

Whenever scientific institutions use (old and new) channels for presenting their information in terms of formats mimicking science journalism, these activities may – besides content-related problems – lead to decreased supply of such topics by journalistic media on the market – also because recipients interested in scientific topics and showing a willingness to pay could become loyal to such new free services. Then, due to potentially further decreasing revenues, the possibilities of science journalism, both in independent and editorial contexts, are further getting restricted. Another reduction of the number of employed and freelance science journalists, partially moving to economically more secure jobs in science PR, would have consequences for reporting on current events: In all likelihood, the professional journalistic expert knowledge of editorial staff would decrease. However, an appropriately-sized, stable, and professional culture of science journalism is of great importance to the whole science and educational system.

73 Lobe 2016.

3.5 Consequences of Digital Science Communication for Science

The developments of the digital public sphere and the transformation of intermediaries (both in general and specifically in science communication) analysed in previous chapters have consequences for science itself. The technological multi-optionality and openness of digital forms of science communication (especially on Social Media) also lead to fundamental transformations within science. Two developments should be specifically mentioned here: The lowering of the gatekeeper threshold in science and science journalism, as well as the evaporating boundary between professional and general audience. In both cases the range of what is observable and what can be influenced changes.

Gatekeeper threshold and quality control

Previously, inner-scientific communication and (science journalistic) media featured a gatekeeper threshold, which had to be crossed before scientific results or journalistic contributions were published. These gates provided a form of quality control, but also – a common criticism – a form

of power of opinion. Both science journalism and professional scientific publications have lost their gatekeeper monopoly on the internet. Publication decisions with potentially broad reach can now in principle be made by all actors (self-publishing). Each layperson can blog on scientific topics, and all scientists can publish their own results and opinions. Beyond that, phases of scientific acquisition of knowledge (Open Science) and of journalistic production (Open Journalism), previously hidden from public view, are being made transparent.

This increase in participation and transparency is countered by the loss of comprehensive quality control before (!) publication, which previously was performed by peer review in science, and editors in journalism. However, mediators do not completely disappear on the internet, for there is still a need for orientation on the side of the audience.[74] But such mediation and selection services are no longer just performed by professional media for a general or professional audience, but also by scientists (Open Access, Open Peer Review) and the audience (Citizen Journalism) itself – or it is performed by algorithms. Whether post-publication curation (see box on page 12) of possibly initially incorrect or insufficiently secure information leads to the corrected scientific knowledge being collectively remembered or whether the original misinformation dominates permanently is still an open question. Previous analyses, however, are mainly causes for pessimism: "Many mechanisms cause false information to gain acceptance, which in turn generate false beliefs that, once adopted by an individual, are highly resistant to correction", is how Del Vicario et al. summarise the state of research.[75]

74 Cf. Neuberger 2014.

75 Del Vicario et al. 2015. Scientific publications know for some time now that retracted articles continue being cited and sometimes even increasingly so (cf. Retraction Watch 2015). Research on refutation also shows the refuted information more likely to be remembered as true than its retraction or refutation (cf. Weingart et al. 2017; Ecker et al. 2011).

The boundary between professional and general audiences dissolves

A second boundary of differentiation also loses importance on the internet: The boundary between general and professional audience seems to become generally more diffuse, if it doesn't dissolve altogether. The general public gains enhanced insights and opportunities for participation through transparency: The (at least technological and organisational) access to scientific knowledge becomes easier, dialogues between citizens and science are easier to organise on the internet. The same is true for participation in research (Citizen Science) and its funding (Crowdsourcing). By this blurring between the two audiences, scientific discourse not only becomes directly observable from outside science, but can also be criticised directly. Although campaigns against individual scientists or scientific theses were present before the internet as well, these can now take place with broader effects. Reputable scientific arguments and pseudo-scientific arguments are often hard to distinguish by laypersons. The potentially increased visibility of science is countered by the risk of losing this visibility in the mass of options (which are often easier to consume and/or distributed by advertising) on the internet. Another result may be for communication from science (including its originally inner-scientific areas) submitting to the dictates of higher speed and emotionalisation, even up to social desirability anticipated in Social Media.[76]

This is especially true when science-external communication activities of scientists are captured by performance measures (also see the following box "Expert opinion for the working group"), based on the attention of the general public (for example Twitter followers),

76 The immediate reaction on Social Media could also have an influence on scientist's decision on what they want to research (for example due to a shitstorm to be expected). This corresponds to a radicalisation of medialisation (cf. Weingart 2012).

Expert testimony for the working group (excerpt)

Risks of using altmetrics for performance evaluation of science communication:

"If the calculation of such scores is also based on user behaviour, new avenues for manipulation open up. Initial approaches can already be found on Social Media. A simple possibility is automating communication by so-called bots. It is estimated, that ten percent of all accounts on twitter are operated not by humans, but by programmes.[77] In the field of science, this is easily realised with an inventory of quotes, links, and references, preferably to publications of an author, whose altmetrics scores are being increased in this way. Another possibility is the creating of entire groups of artificial accounts, communicating with each other, in order to generate, for example, mentions, references, and discussions on particular authors or publications. While it is possible to identify such spurious discussions by the course of the discussion, but adapting them to human behaviour will quickly be achieved in this area. For the providers of scientific Social Media platforms, this leads to the continuous task of countering a devaluation of the altmetric used, just as search engine providers are continuously fighting search engine optimisation, which generates higher scores for specific websites by similar means in order to place them higher on result lists."

Lobin 2016, p. 25.

and which may compete with inner-scientific reputation.[78]

On the part of the science system this may be further advanced by recognising response rates in (especially social) media as another performance measure (see box on altmetrics on page 40). Due to the responsivity expected of science communication, capacities of scientists originally destined for the research process may be relocated – which, in extreme cases, may lead to a misallocation of resources.[79]

Beyond the presented examples at the interface of inner-scientific and communication geared towards the broader public (which is the focus of the present paper) there are a number of other effects of digitisation for inner-scientific communication, which cannot be addressed here. In summary it can be said, that in general the digital scientific public sphere is harbouring the same opportunities and risks previously identified for the digital public sphere in general.

Freedom: The internet can increase the freedom of science and of expression. At the same time, states and corporations can gain control over it.

Equality: While the internet, in principle, opens up easy access to scientific knowledge and possibilities for citizens participating in science, here as well, a digital divide is looming.

Integration: Without a shared public space with equal institutional discourse norms and quality standards, a plurality of criteria and tools for generating and evaluating knowledge develops. Such pluralisation may be perceived as increased freedom against pressures of integration, but scientifically dubious world views arise specifically in echo chambers, thereby posing a danger.

Quality of information and discussion: New forms of science communication – YouTube videos in the style of

77 Cf. on this and further estimates also the box on Social Bots on page 37.

78 Intra-scientific metrics like the impact factor are themselves highly problematic. (see page 44/45 and recommendation 5, page 46).

79 On the relationship between traditional metrics and Social Media cf. Liang et al. 2014.

Altmetrics

Altmetrics are quantitative tools for measuring the impact of research. In contrast to citation indexes (for example simple counting of citations, the journal impact factor, or the person-centred h-index) altmetrics are not based on scientific citation databases, like Web of Science or Scopus, but on data generated on Web 2.0 by news media, Social Media, or online reference management programmes. These data may refer either to the publication or to a person as its author. Altmetrics consider not only scientific impact, but also the impact of research on society. There is some evidence for a correlation between traditional bibliometric measures and altmetrics, but only little research on the question of what they are actually measuring, and whether visibility in Social Media has the same meaning as citation impact.

Sources: Franzen 2015; Holmberg 2014

science slams – are able to reach new, for example younger, target groups. Due to the lack of an institutional or journalistic quality control in professional and general audience, and due to new, in part unconventional forms, enforcing orientation on scientific or journalistic standards becomes harder. Scientists are possibly faced with campaigns; the discourse rules of science or journalism are suspended in large parts. However, the lack of evaluation may also decrease psychological inhibitions for participation, which enables unusual subjects getting a chance to be published and debated.

Diversity: The new platforms create a variety of new forms of mediation. Although increasing diversity is generally positive, (new) intermediaries of scientific communication, that is the providers of network platforms and search engines, may achieve power of opinion, making decisions based on their commercial goals. This may lead to increased discrimination of individual scientific disciplines, controversial theories, and complex scientific messages compared with seemingly simple truths. This possibility of influencing becomes especially problematic where such intermediaries with their access to huge amounts of data are participating in science itself, like for example Google in medicine or artificial intelligence.

Transparency: The audience achieves deeper insights into science and can increase their participation, scientists and scientific institutions can directly appeal to the audience, bypassing journalistic gatekeepers. However, the blurring of the boundary with the professional scientific audience makes science more vulnerable to unwarranted attacks or misunderstandings.

4. Recommendations with Explanations

Social Media came into society as a new, and initially often underestimated, technology and now revolutionise its communication. The discrepancy is telling: The often quasi-monopolistic platform providers claim to be merely commercial advertising companies, and use this label to disclaim most social responsibility, even though their power now reaches that of media in the sense of a "fourth estate" relevant under constitutional law. They promise undreamt-of possibilities with respect to reach, diversity, and individual and temporal immediacy. Indeed, they offer – also to science communication – new and interesting opportunities for knowledge dissemination and the dialogue between science and society. At the same time, they represent a challenge, possibly even a threat, to one of the most important values of modern democratic societies: reflexive, moderated deliberation, which only with constant recourse to sound knowledge is able to find compromises between competing interests, and thus ultimately guarantee social cohesion. Against this background, the academies make the following recommendations.

Recommendations for political decision-makers

Demand for regulation and intermediaries
Social Media, in conjunction with the digitisation of society in general and digitisation of communication in particular, are among the central drivers of accelerated structural change of the public sphere, which is also relevant to science communication and its public spheres. This structural change makes new spaces of interaction and information exchange available, expands the existing arenas of the public of mass media and the public of experts, and diffuses their boundaries, as well as the boundaries between primarily interest-driven and primarily truth-driven communication committed to critical education. Furthermore, novel forms of selecting and presenting information become possible, manifesting themselves in shifts in meaning between the general public and the public constituted by personal communication.

This development was driven by platforms enabling their users to exchange information in many different ways, but which also influence them in a stronger way than is commonly perceived: Companies in partially monopolistic positions like Facebook (including WhatsApp and Instagram), Google (including YouTube), or Twitter are among these, but also specialised academic network platforms like ResearchGate and Academia.edu, as well as (much smaller) blog portals.[80] However, commercially-oriented intermediaries or other media providers dominating this newly constituted public sphere or the field of "Science Communication 2.0" is quite undesirable from the point of view of society, unlike alternative forms of collectively-oriented communication ("Commons-based Peer Production"[81]). Wikipedia (funded by donations) or the blog portal hypotheses.org, funded by several science-related institutions and foundations are successful counterexamples in this spirit; large parts of the blogosphere

80 Cf. among others van Noorden 2014.
81 Benkler/ Nissenbaum 2006.

are non-commercial and committed to the ideal of a de-centralised sharing of information and opinion.[82] Even though science communication is not the focus in these cases, it will be affected by any possible decision.

Whereas previously broadcasting licenses for electronic media (TV and radio stations) were coupled with strict conditions, nowadays everyone is a potential broadcaster to the wider public. While this, on the one hand, accedes to the demands of more direct democracy, it on the other hand enables concentration of media power and its abuse through the spread of disinformation and "fake news". Until now, Social Media have not been regulated by media law in ways appropriate to their journalistic importance. The regulations for journalistic-editorial content given by the Interstate Agreement on Broadcasting and Telemedia (Staatsvertrag für Rundfunk und Telemedien) are mostly inapplicable here.

Recommendation 1: Apply media laws to regulate platforms and search engines

The structural change in public communication initiated by Social Media should be carefully analysed, regulated and accompanied by appropriate policy measures. Under conditions of media convergence, Social Media platforms possess power of opinion, and are to be included in regulatory practices accordingly. They should not be judged solely according to economic and anti-trust criteria but have to be understood as journalistic publishers influencing the communicative freedoms protected by constitutional law.

Starting points to be pursued further can be found in the observations and discussions by the media authorities of the federal states. Measurements of power of opinion should be adapted to the situation on the internet and the role of platforms. Structural diversity on different platforms, as it exists in broadcasting (dual broadcasting system), should be secured. Free access to markets of information, media, communication, and knowledge, without commercial direction through filtering, need to be safeguarded (problem of the market-dominating position of individual search engines like Google etc.). The process of convergence between the media, IT, and telecommunication industries impacts the nationally organised, medium-sized press, as well as public broadcasting. Regulation thus needs to be technologically neutral (extending the concepts of media and programme).[83]

In principle the uncensored, free, and adequate access to all socially relevant sources of information and knowledge must be ensured for all citizens. For this, regulatory requirements for providers of platforms or search engines (for example with respect to filter algorithms) may be necessary. In addition, the newly developed industry needs to be urged to make their operations (for example with regard to data protection, copyright, indicating advertisements, criteria for selection and ranking, criteria for deleting posts, terms of use, general terms and conditions) transparent – particularly when individual data are demanded as quasi-payment for their services. Beyond government regulations, the industry needs to become socially responsible by itself and encouraged to adopt effective forms of self-regulation. The best way to do this are proven forms of co-regulation, as in the regulation of broadcasting. The

82 In Germany, the Bund-Länder-Kommission zur Medienkonvergenz dealt with this, cf. Bund-Länder-Kommission 2016.

83 This perspective is slowly establishing itself in media policy discussions. The report of the Bund-Länder-Kommission zur Medienkonvergenz (June 2016) postulates such a need for action. Transparency regarding the interests of providers, freedom from discrimination with regard to access (securing communicative equality of opportunity), and preventing hegemonic power of opinion, should be legally protected. The founder and primary owner of Facebook, Mark Zuckerberg, faced with critique of his initial refusal to recognise the media character of his company, has by now acknowledged more responsibility; cf. the debate in the New York Times, Isaac 2016.

need for coordinated political measures on the European and the global level, instead of merely on the national level, is beyond dispute. However, political processes of this kind require long periods of time and a small number of platform providers already occupy extremely market-dominating positions. Thus measures on the national level, perhaps also in cooperation with media authorities in the Federal States, need to be taken immediately. Beyond this, the possibilities for creating or supporting public institutions / intermediaries, which secure the public interest in a democratically adequate provision of knowledge and communication have to be examined. In this context, specific responsibilities can be transferred to public broadcasters.

In light of de facto monopoly positions of large internet companies and the resulting outlook, observers fear the danger of blatant market failures in the provision of internet information. This is especially true for the provision of general information, given the decline in print media caused by the internet platforms. This development has progressed most dramatically in the US, but there is no reason to assume Europe and especially Germany will not face the same development. As supply of information is an essential condition for a functioning democracy, the state should have a natural interest to safeguard it with regulatory measures. This applies to guaranteeing both the general supply of information, and, more specifically, supplying the general public with information on scientific developments.[84]

Recommendation 2: Safeguard the independent supply of information on the internet

In order to make the information supply on the internet less dependent on the influence of individual providers, such as Google, Facebook, Twitter, etc. and to react to the problem of filter bubbles (see page 24), the legislature, as well as policy-makers in the fields of media, education, and business, have to develop long-term policies in collaboration with relevant actors (see below). Specifically, they should evaluate the legal, structural, and content-related possibilities of developing a journalistically independent nationwide platform for information and science communication, with content intelligible to a wider audience. This platform should aggregate information from different providers (for example general media, scientific journals, research institutes) on scientific results, evaluate them editorially, and make their origin transparent. The responsible editorial staff has to work independently of government and scientific organisations under an editorial advisory board. The development of such a platform has to ensure it is not directly competing with independent science journalism (for example through appropriate licensing models) but rather strengthening it. In addition to foundation grants, a form of financing (perhaps following models from public broadcasting) may be found on the basis of public funds, which previously financed (in parts quite inefficiently) measures of science marketing.[85] The legislature should call for an expert commission, consisting of representatives of public broadcasters, publishing houses, journalists associations, Social Media experts and representatives of science PR (for example idw), the Science Media Center, scientific institutions, as well as schools and other educational institutions, in order to examine the actual feasibility and, if necessary, the planning and formation of such a platform. This expert commission has to deal with legal questions (for example the aggregation of third-party content), possible economic effects on the business model of private-sector science journalism, as well as the specific techno-

84 Cf. McChesney 2014; Pickard 2015.

85 A role model for parts of the recommended approach could be the Swiss platform Zora (Zentrum Öffentlicher Raum des Schweizerischen Städteverbandes): http://www.zora-cep.ch/.

logical elements of such a platform (for example the implementation and marketing of a search engine based on scientific knowledge, or of a Social Media network enabling improved discoverability beyond search engine monopolists like Google), in depth. This recommendation should also be seen against the background of a possible medium-term market failure in large parts of publisher-based scientific reporting (see tables 1 and 2 in the appendix). In such a case, at the latest, this would need to be countered by a preventative concept, at least reducing the strong dependence on providers of platforms and search engines (mostly located outside of Europe).

Future role of journalism

The key function of journalism for a working democracy, especially in the digital age, is affirmed, and also protected by the constitution. The same is true of science journalism, whose importance in modern knowledge societies continues to be the critical observation of science and its interaction with other social fields and especially with politics. In this (primarily) private sector journalistic media and public media need to be distinguished.

In the latter case, the crisis of science journalism, observable in recent years, suggests the responsible bodies (broadcasting boards, state media authorities) should further specify the programming mandate of public broadcasting. On the part of the legislature, these bodies should be strengthened in order for them to increasingly enable and demand adherence to appropriate guidelines. On the one hand, this includes strengthening their education and information mandates in relation to the entertainment mandate (which in times of a very diverse supply in the digital age seems less pressing). On the other hand, more representatives of the sciences need to be included in such bodies, where they are underrepresented in terms of the social importance of science and research. By means of empirical analysis of structure and content, the (partially obvious) previous deficits in science reporting and the respective editorial structure, especially in current formats with wide reach, should be evaluated. Scientific organisations can contribute to this. Undue influence on actual programming in order to advance particular interests (for example by representatives of individual universities or other scientific organisations in the advisory boards) should be avoided; instead the goal is the articulation and assertion of the public interest in reliable factual information, especially by public media.

Recommendation 3: Strengthen the education and information mandates of public broadcasting

Public broadcasting remains indispensable for the elementary provision of information and knowledge for all of society. It needs to be enabled to increasingly provide targeted services, also within the field of science communication and as well as online. For science journalism to be more widely used in information services provided by public broadcasting, the extent to which public institutions can establish their own platforms (see recommendation 2) for science-related information, for example in cooperation with European public broadcasters and other partners, should be evaluated. In light of their special responsibility, guaranteed funding, and long-term guarantee of maintenance and development, public broadcasters should cultivate and expand their journalistic services on the topics of science, technology, and medicine, as part of current affairs, beyond programming aimed at particular (or even minority) targets. We recommend stronger connections of main programming with cross-media services, especially with respect to a younger target demographic.[86] We recommend the relevant bodies and especially the scien-

86 It should be pointed out that this may affect fundamental debates on the Federal and State level regarding the tasks, structures, and work of public media providers and the respective legal framework.

tists represented there to wholeheartedly support such efforts. The education and information mandates are to be strengthened in relation to the entertainment mandate.[87]

Current developments in the reception of media, especially the loss of attention incurred by traditional media, sometimes led to dramatic effects for journalism funding by advertisements and paying customers (cf. regarding the development of circulation of selected weekly publications for example table 2 in the appendix, page 58). By now the field of science journalism, which in some segments was quite stable until recently, experiences similar developments.[88] The Social Media platforms do not provide science journalism in the sense of producing journalistic and editorial content.[89] However, journalistic media are now dependent on these platforms for distribution of their services (for the reach of Social Media services see table 3 in the appendix). This relation of dependency is a problem for journalistic media (see chapter 3.4); accordingly alternative models of funding to support independent journalism are called for. There is discussion among media economists whether to treat information produced by the news media as a public good, due to its importance for opinion-forming and controlling processes in a democracy. This would lead to specific consequences for government regulation beyond market mechanisms.[90]

87 Cf. on this the report "Legitimation und Auftrag des öffentlich-rechtlichen Fernsehens in Zeiten der Cloud" by Dörr et al. 2016: http://www.zdf.de/ZDF/zdfportal/blob/45517114/5/data.pdf.

88 On the development of circulation numbers of knowledge magazines cf. Beck/ Dogruel 2016, page 9 ff., and table 1 (page 58).

89 Social Media platforms can take over quasi-journalistic functions, for example the pre-selection of news by Facebook and Google, cf. Lilienthal 2016; Bell 2016. Until quite recently most providers of Social Media platforms denied this quasi-journalistic role and described themselves purely as technology providers.

90 Cf. Pickard 2015, 213 ff. For example, in January 2017, the State Parliament of North Rhine-Westphalia prepared a motion for a resolution to consider altering the fiscal code on state and federal level, and even take the initiative if necessary, in order to create or improve a framework for not-for-profit journalistic activity (cf. Landtag Nordrhein-Westfalen 2017).

Recommendation 4: Support science journalism following the model of research funding

Against the backdrop of digitisation and continuously weakening funding models, numerous segments of science journalism are entering a precarious situation. Thus, foundations and the government should evaluate further possibilities of funding and support, starting from the principle of media-produced information being a „public good".[91] Funding decisions could follow models of research funding (funding of quality journalism on the basis of expert/jury decisions with significant involvement of journalists and their trade associations, similar to film and scholarship funding). Government measures in the fields of information and communication, that is in the entire media and communication sector, are fundamentally problematic with respect to democratic theory. Still, in the spirit of cost-neutral redistribution, the (co-)funding of government-independent foundations, themselves initiating and evaluating funding measures is conceivable. Here, as well, the funding principles of science can be used as a model.

Recommendations for the scientific community

Science organisations and performance measurement

Scientists in universities and research institutions are increasingly subject to performance measurement regimens (for example citation indices, impact factors, h-index), intended to represent science-internal communication. These performance measures have led to goal displacements in the behaviour of scien-

91 Cf. Pickard 2015 and the literature given there on page 213, footnote 4; cf. also McChesney 2014, 7: „[I]n democratic nations, journalism subsidies tend to make the press more diverse and dissident and critical of the government in power. Like education, it is a public good, and, as with education, the more resources that are devoted to it, the better it will be, everything else being equal."

tists, for example the so-called "salami slicing" of publications.[92]

Recently, requests from politicians for scientists to communicate to the general public, have led to a search for analogical measures, mainly focused on registering attention in Social Media (altmetrics). The political support for orienting themselves to (undifferentiated) attention is particularly appealing to scientists, as it seems to match the mandate for transparency and accountability required in a democracy. However, the reduction of this mandate to maximising mere attention in fact means a perversion to be counteracted. Measures like "reads" on ResearchGate (science-internal attention) and the number of "followers" on Facebook (science-external attention) are informally used as performance measures and blended in an undifferentiated fashion.[93] In Germany the establishment of new platforms[94] and correlated measures of attention can already be predicted. The unreflected use of such measures, untested for possible unintended consequences, may lead to further shifts in objectives, such that media popularity may attain a significance comparable to inner-scientific reputation, or even surpassing it, thereby calling into question the quality standards of science.[95]

Recommendation 5: Avoid false incentives in science communication

Scientific organisations and funding institutions are called upon to carefully consider unintended side effects and possible dysfunctions when providing incentives for communication of research results and for communicating with the public. There should be intensive promotion of research on developing sensitive indicators, encouraging responsible communicative behaviour.

92 Cf. Butler 2010.

93 Cf. Van Noorden 2014, 127.

94 Cf. for example the statements regarding The Conversation (p. 33) and Bruns 2017.

95 Cf. also American Sociological Association 2016.

Self-mediated science communication and Science PR

Also on Social Media, science journalism and self-mediated science communication by scientists / science PR do not represent functional journalistic equivalents, but instead fulfil complementary, in some cases even unique functions.[96] They should accordingly not be played off against each other. There are, beyond individual cases,[97] generally no sufficient indications for targeted and systematic attempts at substituting scientific journalism for other forms of science communication. At the same time, the respective services compete for the same attention market, especially in the digital age. This leads to a dilemma: On the one hand, science journalism, facing free alternative offers from science, has to continue reasonably operating under changed market conditions, which itself is in the long-term interest of science. On the other hand, the new media possibilities of self-mediated communication via internet and Social Media can be used for direct forms of science communication with, for example, younger users, increasingly less reachable by journalistic media (substituting function). Additionally, (science) journalists are among the groups of multipliers easily reachable via Social Media.

Publishing elaborate knowledge magazines as printed products or corresponding digital operations (for example expensive image videos) of individual research institutions seems quite inefficient in such a competitive market, and also in the face of considerable costs. Due to the limited amount of media reception by potential recipients, they can also intensify or cause the aforementioned substitu-

96 Cf. for example Kohring 2005, p. 113–119.

97 An example for such a singular action was the retail sale of the Leibniz society print journal. In September 2012, the research organisation placed their "Journal" at 400 airports and train stations – next to magazines like "GEO" and "Spektrum der Wissenschaft" – for a retail price of three Euro. According to the former spokesperson, the print run was 19'000 strong, while only 126 magazines were actually sold. The retail experiment was thus canceled after four issues, and free distribution was expanded instead.

tion effects at the expense of journalistic products, thereby worsening the already difficult situation of science journalism financed by its readers. In contrast to this, cross-institutional platforms (like "The Conversation", well-known in several countries) have a higher efficiency, however, the problem of substitution is even more severe in their case. In general, research institutions should evaluate which option offers the best cost-benefit ratio for each form of science communication: Using classic journalistic multipliers, a cooperation of research institutions (even competing ones) on the same topic, or individual direct communication geared towards a specific target group.

Since science-related content faces increasing competition by the diversity of Social Media, the ability of scientists to determine science communication and science PR should not be overestimated. Given the high level of sophistication (for example with regard to comprehension) expected by many services offered by science, the ability to directly communicate to a broader public may in many cases be lower than that of professional mass media science journalism. A liberation from the logic of media, that is the demands of journalistic selection and presentation, should not be expected even for direct communication. On the contrary: Further incorporation of this media logic by scientific organisations, or at least their PR departments, should be expected, favouring especially popular topics and disciplines in external communication.

Using Social Media as a complementary form of communication is particularly useful for research institutions for achieving a direct dialogue with the target groups or even reaching additional ones. It allows users to ask questions, give feedback in the form of comments or "likes" and share content with others. Institutions are given chances for answering early on, as well as identifying misunderstandings, moods, and tendencies and react to those. Without a professional strategy, good moderation, and appropriate resources, benefits will remain marginal; in some cases the effects to be expected may even be counterproductive.[98] Further consideration needs to be given to the effects of filter bubbles and echo chambers (see pages 23 and 24) on this form of communication. Topics, which some years ago would have appeared marginal, can develop into veritable communication crises (for example militant animal rights activists using Social Media shitstorms to call for violence against scientists). Professional science PR enables participation in the work practices and results of science and thus creates and promotes trust in science (and not just individual institutions). It advises and unburdens scientists in the case of shitstorms and communication crises in general.

Recommendation 6: Evaluate costs and benefits of institutional science communication formats

Appropriate offers for media training courses should make it easier for interested scientists to find their way into classical media and the use of Social Media. An obligation for such communication, however it is devised, should be avoided in principle (freedom of science etc.). In order to counter a spread of the media logic to the core tasks of research and teaching – for example through misallocation of resources (staff, material, technical equipment, space) – further internal mechanisms to counter such developments have to be

98 Cf. the assessment of Beck/Dogruel 2016, 45: "The supply side itself also seems in need of further research, especially with regard to the activities and resource management of PR in universities and other research institutions. There are many signs that the overwhelming part of resources and content is not geared towards science communication (meaning conveyance of knowledge), but rather strategic organisational communication aimed at reputation and acceptance. We are not concerned with the normative question, whether this leads to undesirable developments in the system of science (for which there is some evidence), but the simple question of whether current structures and strategies are compatible with the idea of self-mediated science communication being or possibly being a functional equivalent for science journalism in the future. Our provisional answer is very skeptical, however, more research is needed."

established. The measures of self-mediated science communication and their use of resources should always (and perhaps more strictly than previously) be subject to strategic planning and cost-benefit-analysis (also see the guidelines for good science PR) in order to use public funds more economically. Against this background, for example the publishing of printed magazines, as well as the use of every additional new digital (for example video) channel, have to be evaluated.

In choosing appropriate communication channels, the aspect of differential credibility also needs to be considered. Science PR and direct communication of scientists are subject to different credibility requirements than commercial PR communication. Especially in so far as self-mediated institutional science communication as knowledge communication (oriented on the ideal of a truth communication) complementarily supplements the complex of media relations and science journalism, or even substitutes it for specific audience subgroups, *credibility* is a central as well as a scarce resource.[99]

Credibility is based, among other things, on transparency, in this case the disclosure of sources and their interests. The novel possibility of (potentially wide) direct communication creates a new journalistic responsibility with regard to integrity in presenting research results. As Social Media business models rely on commercial advertisement, this becomes even more crucial. The advertising industry has an interest in fusing journalistic and advertising content, in order to increase authenticity and thus credibility (so-called native advertising). All institutional PR strategies primarily serving the particular interests of specific individual organisations competing for reputation or even research funding (oriented on the ideal of reputation communication), are easily perceived as tainted sources, whose science communication may be contaminated by organisational interests. They often suffer from a credibility deficit, possibly impeding the credibility of scientists and the scientific institution concerned. This can only be countered with transparency regarding sources.[100]

Responsible science PR thus also means protecting one's own institution or individual scientists from possible negative consequences (such as loss of credibility) of communication without integrity, merely geared towards short-term visibility. In general, scientific institutions and science PR have to establish a new culture of responsibility in science communication, as already partially outlined by the guidelines for good science PR.

Recommendation 7: Separate fact-based science communication and science marketing

The growing possibilities of direct communication with the final user, without prior assessment and selection by (ideally) science-independent journalists and editorial staff lead to new responsibilities for self-mediated science communication. The press and public relations work of science organisations needs to be identifiable as institutional communication, for example in the spirit of advertisement and paid special supplements to journalistic printed media being identifiable as such (press code, section 7). Confusion with independent journalistic science communication is to be avoided at all costs. Scientists have to be transparent in their Social Media communication, as to which roles they are taking (scientific expert, teacher, representative of individual or institutional interests). In any case, the standards of scientific integrity and quality control

99 Cf. Schäfer 2016.

100 Cf. Meier/Reimer 2011. The authors discuss the transparency mandate primarily for journalism and also refer to risks for journalistic objectivity. On the relationship between transparency and trust on internet communication, among others, cf. Ibid.

have to be met in external communication as well (cf. recommendation 1- 4 by WG WÖM1). In contrast to tendencies towards consolidation in "departments for public relations and marketing", in the spirit of transparency, PR and press departments or departments for science communication have to be (once again) clearly separated from marketing departments acting according to advertising industry standards; comparable to the structural separation of editorial staff and advertising department in journalistic publishing houses. In the case of universities, bodies primarily responsible for science communication in its original sense, rather than "reputation communication" could be put under the control of the senate or a comparable controlling body[101], instead of the head of the institution, as is already the case with other commissions (for example for safeguarding good scientific practice) acting independently of the particular interests of the individual institution. At the very least, such a separation has to be visible from the outside in the activities, operating procedures, and products. Thus, scientific institutions should, where ever possible, not make use of the possibilities of native advertising.

Rules for and evaluation of honest science communication

The academies play a special role among the scientific organisations, as they are less subject to demands of profile raising than university and research institutions, and can take on a more neutral and conciliatory position between them. They are thus credible, their positions carry normative weight both within science and externally to the public and political actors. From this results an increased responsibility of the academies to take on this role in questions of science communication or the supply of the public with reliable information from and related to science in the most independent way possible.

101 Cf. on this also Wormer 2016.

Recommendation 8: Develop a code of conduct for the web and Social Media

We recommend the development of proposals for a quality-oriented code of conduct for information on the internet and especially on Social Media.[102] It should be developed independently of institutions or associations, with involvement of the Social Media community and its own rules ("Netiquette 2.0"), as well as professional and quality standards of science (for example good scientific practice, publication standards in scientific journals) and journalism (for example good scientific practice, press code). This aims at creating transparency and closing gaps not yet covered by self-regulation, and which cannot be covered by (for example legal) regulation. Such a code of conduct should meet at least the standards customary for such regulations on safeguarding transparency and declaring conflicts of interest and institutional affiliations of the respective authors, and the funding of projects, as well as citing sources, and further standards for certifying providers or content with appropriate "quality labels" or the like (in some areas such quality labels are already being tested – for example afgis for health websites). Possibilities and broadly applicable methods for verifying the authenticity of contributions (for example identifying contributions by so-called social bots) should be further discussed and expedited.

Science communication has differentiated itself and expanded, both under the influence of political steering of science (through, among others, increasing competition of scientific institutions for resources) and of digitisation. Ideally, especially institutional science communication advises and unburdens scientists in the efficient use of their (public) communication, especially with respect to new digital

102 The following possible actors could be examples: ombudspersons of scientific institutions, representatives of Siggener Kreis, netzwerk recherche, Wissenschafts-Pressekonferenz, Presserat, Stiftung Warentest, representatives of platform providers, representatives of re:publica, and of scientific blogs.

challenges (cf. page 37). The growing number of actors in science PR and the differentiation of functions neither contributed to increased quality of science communication in all cases, nor is their commitment to the common good guaranteed. It is thus in the interest of science communication organisations to monitor these developments closely and protect them against abuse.

Recommendation 9: Promote technological impact assessment of digital media

In light of a rapidly transforming science communication, its observation and evaluation should be permanently institutionally embedded within the sciences (for example at the academies) – as part of a long-term technological impact assessment of digital media on the communication and opinion-forming processes in a democratic society dependent on reliable scientific knowledge.

Scientists as Experts

Traditionally, the code of conduct of science included an avoidance of public communication (especially with regard to self-advertising) as well as publicly voicing political positions. This abstinence, geared towards guaranteeing scientific neutrality, has to be reconsidered and adapted to the changed social and technological conditions: The mandate of scientific neutrality is valid as ever, but scientists are called upon to show social (and political) commitment and maintain communication with the public on scientific topics and scientific practice. They accordingly have to help shape public discourse through their expert opinions, but also be able to express themselves as active citizens. Transparency about the role occupied at each time is desirable.

Recommendation 10: Strengthen public communication and demarcate disambiguate roles

Scientists are encouraged to introduce their expert knowledge into public discourses and political debates, thereby exercising their social responsibility. Here, Social Media opens up special opportunities for reaching especially younger target groups. They also have the technical potential for desirable multi-directional interaction of scientists, press offices, and the public. In this, the principles of integrity in communication and good practice in science communication (cf. recommendation 8, as well as recommendation 3 from 2014) have to be observed, and responsible use has to be made of the available time and financial resources, beyond actual scientific practice. Furthermore, in order to avoid endangering the credibility of science itself, the role in which scientists and especially scientific officials take part in the debate (for example as expert, teacher, private person, representative of a research institution) has to be clear at all times.

Recommendations for educational organisations and educational policy

Media competence and evaluation of sources

The introduction of the internet and Social Media, especially the speed of their spread as new technologies, and their effects on society and political institutions have been dramatically misjudged by politics, the public, but in parts also by scientific actors. This particularly concerns the topics of trust in communication and responsible use of data. The everyday use of smartphones and social networks, the connected aggregation of data tracks, and the recording of behavioural patterns led to profound changes in behaviour, without their long-term effects for social cohesion having received sufficient reflection yet.[103]

103 In the last few years, there have been isolated activities like the "Day of media competence" at the State Parliament of North Rhine-Westphalia (www.tagdermedienkompetenz.de), which was revived following a break of some years. On the situation of media competence of US pupils cf. Stanford History Education Group 2016.

Recommendation 11: Improve media competence and evaluation of sources in schools and other educational organisations

Information on Social Media can often be hard to attribute to sources. At the same time, abilities to evaluate sources (for example media brands) with regard to their trustworthiness are decreasing. For this reason, we recommend massive measures (for example the development of appropriate curricula) for acquiring and improving digital media competences and evaluation of sources in schools and university, but also in vocational education, trainings, and further education. In this, methods for evaluating information from different sources and intermediaries need to be conveyed, and an understanding of the workings of different digital media, as well as its selection and aggregation criteria needs to be created. Aspects of data and privacy protection in using digital media also need expanded consideration.[104] The federal and state governments, but also organisations operating private educational institutions and community colleges, are called upon equally.

Recommendations for research

With regard to many of the issues raised, there are no or insufficiently reliable empirical results. Research projects on the internet and Social Media have commenced in many places, but the transformations are so rapid and profound that research needs exceed capacities. This leads to many of the statements and recommendations expressed in this paper having only provisional character. Especially the social and political sciences, as well as communication and media studies are, often in cooperation with computer science, technology, and engineering, called upon to meet this demand. For this, they need to reorient themselves accordingly and adapt their agendas with regard to content and timing. Conventional programmes for funding research, where the idea of the proposal and the completion of the project may be years apart, are regularly running risks of lagging behind current developments in digital communication, and only being able to reproduce them afterwards. Not least for this reason, the Federal Ministry of Education and Research is planning a "German Internet Institute", expected to become operational in 2017.[105]

Recommendation 12: Further research on the effects of digital media and establishing of responsive funding lines

The working group postulates considerable demand for further research on the workings and effects of digital media on science communication and provides a catalogue of relevant topics. With regard to research funding, the establishment of funding lines (like for example possibilities of "rapid grant application") with funding duration, funding scope, and speed of funding decision, enabling research to keep pace with the extreme dynamism in the field of public communication, is recommended.

Research needs

There is too little reliable empirical knowledge on the importance of Social Media and further digital possibilities of communication in and for science communication in many areas, as well as on their impact. There is urgent demand for research in at least the following cases:

104 Cf. also di Fabio 2016; Schweizer Jugendbarometer 2016.

105 Cf. BMBF 2016. "The aim of the planned institute is to better understand digitisation and harness it for the common good of society. For this, intensive, interdisciplinary research on the societal, economic, legal, and political aspects of digitisation, on the basis of a profound understanding of technological development, is needed."

- While there are regular and reliable surveys on the prevalence and use of Social Media in the population, there is little reliable research on its prevalence among scientists and professional communicators in universities and research institutions. A regularly repeated survey on this is desirable.
- Representative empirical surveys on the use of scientific content in different online arenas[106] are desirable: How are people confronted with scientific knowledge, what importance is given to different communicators and forms of presentation, especially for attributing credibility?
- Assigning relevance to and certifying publicly available information, a task previously and for a long time the responsibility of journalists, is now performed by other actors as well. To what extent can selection and sharing behaviour be described in terms of classical news factors – and if so, by which one? (Possibly relevance as a news factor plays a lesser role compared to entertainment value.)
- Given the structural principles of intermediaries, there is urgent research demand for the effects of algorithmic filtering, automatic content generation, and information personalisation. How significant are scientific sources in the information repertoires of Social Media users? Scientific results on how academically specialised intermediaries are contributing to a widening or narrowing of information sources, for example by algorithmically strengthening disciplinary echo chambers, are lacking.
- Complementary to this, the question of how disinformation and/or pseudo-scientific theories and claims spread and last, while bypassing former gatekeepers, needs to be researched.
- The development of new, widely applicable measures and technological methods for verifying and examining the source and authenticity of digital information in Social Media (for example identifying bots in tweets), but also in texts, sounds, and images generally is an urgent desideratum for research.[107]
- The consequences of a progressively lessening impact of journalistic reporting (on science) on the formation of public opinion and the spread of science-related information is an open task for research, as well as the possible investigation of alternatives and countermeasures to this development.
- Analogous to large education studies (PISA, TIMMS) and/or possibly in connection with those the systematic collection of media competences and source evaluation skills of pupils, trainees, and students, as well as the development of efficient tools and methods for strengthening such competences are needed. Similar approaches should be used for training teachers and general adult education.

106 On the differentiation between different arenas cf. the expert opinion by Schmidt 2017.

107 Against the background of current software development – for example the "VoCo" project by Adobe ("Photoshop for audio") –, which "can form words and sentences in the voice of an arbitrary person" (cf. Boie 2016), this is no longer just true for images and text, but also for the verification of audio documents.

On the 2014 Recommendations

The June 2014 position paper "On Designing Communication between the Scientific Community, the Public and the Media" shows members of the working group of the academies making recommendations for the scientific community, for politics and society, and the media (see box on page 16). In the spirit of sustainability, a short overview of how far these recommendations have been implemented by now is in order (while noting, that a causal connection cannot be inferred in each case). Furthermore, the following presentation merely gives examples and does not claim to be exhaustive.

Implementation and developments in the context of science:

Regarding Recommendation 1 (2014)[108]: The imperative of "integrity in science communication" demanded by the 2014 position paper has been taken up by scientific actors in a number of activities. The role of Siggener Kreis, founded by Bundesverband Hochschulkommunikation and Wissenschaft im Dialog, and primarily consisting of representatives of science PR, should be highlighted. This group already developed a first paper in parallel (and already in exchange) with the first working group of the academies. In the following, with participation of journalists and partially advised by members of the working group of the academies, this was further expanded to become "Leitlinien für gute Wissenschafts-PR". These guidelines state demands for actors in institutional science communication – and thereby take up the 1998 recommendations by Deutsche Forschungsgemeinschaft (DFG) for "securing scientific best practice", a form of scientific self-regulation which achieved general consensus. The "Leitlinien zur guten Wissenschafts-PR" (Guidelines for good science PR) were presented on the 15th of April 2016 in Berlin.[109] The scientific academies united in the Union of the German Academies of Sciences and Humanities recognised the guidelines approvingly and pledged their commitment. For example, the Berlin Brandenburg Academy of Sciences (BBAW) adopted the guidelines in early 2016 and made them available to its members. In the summer of 2016, the board of the German National Academy of Sciences also introduced the guidelines and arranged for them being provided to its 1'500 members. The Executive board of acatech recognised the guidelines for good science PR approvingly and acknowledges them as an appropriate standard for institutional communication by acatech. The academy advises its members to espouse the guidelines as well. Informationsdienst Wissenschaft (idw) also committed to the guidelines in March 2016.[110]

Regarding recommendation 3 (2014): The resolution "Wissenstransfer in die Mediengesellschaft: Situationsanalyse und Orientierungshilfen"[111] by the

108 On the wording of the recommendations of 2014, see box page 16.

109 Bundesverband Hochschulkommunikation 2015; Initiative Qualität von Hochschulkommunikation 2016; Weißkopf 2015.

110 Cf. on this the recommendation in the position paper 2014: "As a first step the topic should be discussed at, for example, the yearly meeting of spokespersons of idw member institutions. The criteria for the idw award for "best press release of the year" should also be adapted in this regard."

111 Hochschulrektorenkonferenz 2013.

University Rectors' Conference affirms the commitment of universities to knowledge transfer in the face of important technological and social changes and highlights the importance of Social Media. Discussions on this topic also took place at Wissenschaftsrat. The position paper "Wissens- und Technologietransfer als Gegenstand institutioneller Strategien" supports the demands of the working group of the academies to clearly label institutional communication formats of universities and research institutions as such.[112] The recommendations of the academies on integrity in communication were also discussed in the jury of the DFG communicator award, as well as in some university commissions in securing good scientific practices.

Implementation and developments in the context of politics and social agents:

Regarding recommendation 6 (2014): In October 2015, a public expert discussion of the "Ausschuss für Bildung, Forschung und Technikfolgenabschätzung" (Parliamentary Committee for Education, Research, and Technological Impact Assessment) on the topic "Stand und Perspektiven der Wissenschaftskommuniaktion" (State and Perspectives of Science Communication) took place, which was influenced by the position paper of the academies. Excerpts of the paper of the academies were introduced into a hearing on the topic "Beitrag zu Vielfalt und Qualität im Journalismus leisten – Gemeinnützigkeit von Journalismus anerkennen" (Making a contribution towards diversity and quality journalism – recognising the common benefit produced by journalism)[113] by the Committee for Culture and Media on 26th of February 2015 and quoted in some of the statements.[114]

Regarding recommendation 7 (2014): 26 foundations and associations made a call for committing to quality journalism.[115] In doing this, they want to promote the debate on quality journalism and diversity of opinion in the face of transformations in the media landscape and worsening working conditions of many journalists. They further want to motivate other foundations to participate as well – besides the direct funding of journalists also in the fields of "journalistic credibility", addressing the lack of trust, increasing appreciation, as well as research and demand analysis. Some foundations (for example Robert Bosch Stiftung) continue to be practically engaged in the field of science communication, others introduced new programmes – for example VolkswagenStiftung in the field of data journalism[116] and its connections with science. VolkswagenStiftung also granted three years worth of funding for a periodic conference on "Science, Journalism, and Data". The activities of netzwerk recherche on non-profit journalism (https://netzwerkrecherche.org/nonprofit/) as well as the "non-profit newsroom" correctiv (https://correctiv.org/), founded in July 2014 and supported by, among others, Brost-Stiftung and Rudolf Augstein Stiftung, also should be highlighted.[117]

Implementation and developments in the context of media:

Regarding recommendation 11 (2014): A Science Media Center (www.sciencemediacenter.de) embedded with Wissenschafts-Pressekonferenz, trade association of about 220 science journalists, commenced active operations in the beginning of 2016, with support by Klaus Tschira Stiftung.

112 Cf. Wissenschaftsrat 2016.

113 Cf. Landtag NRW 2017.

114 Cf. Schraven 2015.

115 Cf. Bundesverband Deutscher Stiftungen 2015.

116 VolkswagenStiftung 2015; Data journalism was explicitly mentioned as an innovative field in the 2014 recommendations (p. 24).

117 https://correctiv.org/correctiv/foerderer/.

Participating Experts

Working group participants

Working group

Prof. Dr. Peter Weingart (Speaker)	Universität Bielefeld
Prof. Holger Wormer (Speaker)	TU Dortmund
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Dr. Elisabeth Hoffmann	TU Braunschweig
Prof. Dr. Otfried Jarren	Universität Zürich
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Dr. Jeanne Rubner	Bayerischer Rundfunk
Prof. Dr. Mike Schäfer	Universität Zürich
Volker Stollorz	Science Media Center Germany gGmbH
Julia Wandt	Bundesverband Hochschulkommunikation

Methodology and project progression

At the session of the standing committee of the National Academy of Sciences Leopoldina at 04.12.2014, the project "Kommunikation zwischen Wissenschaft, Öffentlichkeit und Medien (Phase 2): Bedeutung, Chancen und Risiken der sozialen Medien" as proposed by acatech – National Academy of Science and Engineering and the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW) was approved.

Written expert opinions were obtained from

- Prof. Dr. Klaus Beck and Dr. Leyla Dogruel, FU Berlin, Institut für Publizistik- und Kommunikationswissenschaft
- Prof. Dr. Henning Lobin, Universität Gießen, Angewandte Sprachwissenschaft und Computerlinguistik
- Dr. Jan-Hinrik Schmidt, Universität Hamburg, Hans-Bredow-Institut

The written expert opinions are published in: Peter Weingart, Holger Wormer, Andreas Wenninger and Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter, Velbrück 2017.

Working group sessions, expert testimonies, and expert discussions

Two working group sessions, in conjunction with expert testimonies took place on 22.06.2015 and on 18.12.2015, featuring the following persons and topics:

- Georg Dahm, Journalist Substanz-Magazin, Situation und Perspektiven des Wissenschaftsjournalismus
- Dr. Florian Freistetter, Independent blogger and author, Freie Blogosphäre
- Christian Herbst, Bundesministerium für Bildung und Forschung (BMBF), Politik
- Prof. Dr. Christian Stegbauer, Goethe-Universität Frankfurt, Fachbereich Gesellschaftswissenschaften, Internet-/Netzwerkforschung
- Prof. Dr. Johann-Dietrich Wörner, European Space Agency (ESA), Management level of science institutions

Further working group sessions took place on 20.04.2015 (Discussion Exposé, Methodology, Planning expert opinions), and on 17.03.2016 (Workshop preparation on 18.03.2016), on 07. and 08.06.2015 and on 14.10.2016 (Developing the position paper).

In addition the following expert discussions were held:

On the relationship between (science) journalism and PR on 27.10.2015 with Dr. Claudia Riesmeyer, LMU München, Institut für Kommunikationswissenschaft und Medienforschung.

On the future technological framework of digital media on 06.01.2015 with:

- Prof. Dr. Christoph Igel, DFKI
- Prof. Dr. Henning Lobin, Universität Gießen
- Prof. Dr. Christoph Meinel, Hasso-Plattner-Institut

and on 21.03.2016 with Prof. Dr. Dirk Helbing, ETH Zürich, Computational Social Science.

On 18.03.2016 a public workshop titled “Bedeutung, Chancen und Risiken der sozialen Medien für die Wissenschaftskommunikation” took place in Berlin featuring the following programme:

Time	Topics and speakers	
09:00 – 09:30	**Welcome and Introduction**	Speakers of the working group: Prof. Dr. Peter Weingart (Universität Bielefeld), Prof. Holger Wormer (TU Dortmund), Prof. Dr. Reinhard F. Hüttl (acatech)
09:30 – 10:00	**Keynote speech on policy**	Dr. Daniela De Ridder (SPD-Bundestagsfraktion, Mitglied Ausschuss für Bildung, Forschung und Technikfolgenabschätzung)
10:00 – 10:30	**Keynote speech on international research**	Prof. Dr. Axel Bruns (Queensland University of Technology, Brisbane, Australia)
10:30 – 11:30	**Session I:** „Social Media as Intermediaries in Science Communication“ *Moderation: Holger Wormer* • Presentation of expert opinions and theses (20 mins) • Comments (5 mins each) • Discussion (25 mins)	Dr. Jan-Hinrik Schmidt (Hans-Bredow-Institut Hamburg), Prof. Dr. Hans Peter Peters (FZ Jülich and FU Berlin), Mirko Meurer (Science Media Center), Franz Ossing (Deutsches GeoForschungsZentrum GFZ Potsdam)
11:30 – 12:00	Coffee break	
12:00 – 13:00	**Session II:** „Economic perspectives of science journalism and science communication“ *Moderation: Reinhard F. Hüttl* • Presentation of expert opinions and theses (20 mins) • Comments (5 mins each) • Discussion (25 mins)	Dr. Leyla Dogruel (FU Berlin) Prof. Dr. Mike S. Schäfer (Universität Zürich), Martin Schneider (wpk), Julia Wandt (Bundesverband Hochschulkommunikation; Universität Konstanz)
13:00 – 14:00	Lunch break	
14:00 – 15:00	**Session III:** „Future technological frameworks for digital media in public communication (with respect to channels particularly relevant for scientific topics” *Moderation: Peter Weingart* • Presentation of expert opinions and theses (20 mins) • Comments (5 mins each) • Discussion (25 mins)	Prof. Dr. Henning Lobin (Justus-Liebig-Universität Gießen) Prof. Dr. Katharina Zweig (TU Kaiserslautern), Dr. Anna Sauerbrey (Der Tagesspiegel), Henning Krause (Helmholtz-Gemeinschaft)
15:00 – 15:30	Coffee break	
15:30 – 16:00	**Visionary outlook**	Prof. Dr. Andreas Hotho (Universität Würzburg)
16:00 – 17:00	**Final discussion**	Moderation: Peter Weingart

A blog on the project „Science communication³“ (http://scilogs.spektrum.de/Wissenschaftskommunikation-hoch-drei/about-the-blog/) was used for discussing the expert opinions and theses of the working group.

On 01.12.2016 an expert discussion with Members of Parliament at the Parliamentary Committee for Education, Research, and Technological Impact Assessment and members of the working group of the academies took place.

The position paper was adopted on 11.04.2017 by The Coordinating Committee of the National Academy of Sciences.

Appendix

Tables

Table 1: Development of circulation numbers "Knowledge magazines"[118]

Title* / Quarter**	2/1998	2/2003	2/2008	2/2013	2/2016
Bild der Wissenschaft	106.283	89.096	94.262	65.442	62.407
Geo	462.458	413.793	346.840	235.131	186.956
Geo Special	123.176	103.914	120.706	96.012	54.846
National Geographic	267.880 **[2/2000]**	244.274	179.303	121.354	102.971
P. M.	402.288	386.947	300.835	189.556	138.299
Psychologie heute	83.298	79.862	79.747	79.179	76.198
Spektrum der Wissenschaft	101.282	96.541	85.684	71.279	61.409
Sterne und Weltraum	13.290	18.910	20.688	18.114	17.515
ZEIT Wissen	-	-	67.055	71.985	63.129

* The numbers represent the sold copies declared by IVW (Total subscriptions + retail sales)
** In case no data was available for a quarter, the values were left empty or replaced with other values [Quarter is indicated in square brackets]

Table 2: Development of circulation numbers of selected weekly publications

Title / Quarter	2/1998	2/2003	2/2008	2/2013	2/2016
Focus	594.416	539.405	477.201	279.228	241.827 (261.804 incl. E-Paper)
Der Spiegel	865.331	895.556	825.934	699.244	577.773 (603.728 incl. E-Paper)
DIE ZEIT	441.176	388.749	410.267	442.975	411.732 (435.302 incl. E-Paper)

* The numbers represent the sold copies declared by IVW (Total subscriptions + retail sales)

Table 3: Reach (Usage)* of Social Media services in Germany 2015

Social Media service	Total internet users**	Internet users 14 – 29 years old
Online networks (incl. Facebook)	43 %	73 %
Twitter	7 %	13 %
Video platforms	62 %	86 %
Videos on Facebook	30 %	57 %

*based on "at least seldom use".
** over 14 years
Source: Tippelt/Kupferschmitt 2015, 443

118 The knowledge magazine of Süddeutsche Zeitung „SZ Wissen" also had to fight heavily decreasing sales numbers in its short history, and was finally discontinued after only a few years (cf. wuv 2009).

Register

References

acatech – Nationale Akademie der Technikwissenschaften/ Leopoldina – Nationale Akademie der Wissenschaften/ Union der deutschen Akademien der Wissenschaften (Eds.) (2014): Stellungnahme. Zur Gestaltung der Kommunikation zwischen Wissenschaft, Öffentlichkeit und den Medien. Empfehlungen vor dem Hintergrund aktueller Entwicklungen. Unter Mitarbeit von Peter Weingart (Schriftenreihe zur wissenschaftsbasierten Politikberatung). Available online at https://www.leopoldina.org/uploads/tx_leopublication/2014_06_Stellungnahme_WOeM.pdf, accessed 06.03.2017

Altmeppen, Klaus-Dieter (2006): Journalismus und Medien als Organisationen. Leistungen, Strukturen und Management. Wiesbaden: VS Verlag für Sozialwissenschaften | GWV Fachverlage GmbH Wiesbaden.

American Sociological Association (2016): "What Counts? Evaluating Public Communication in Tenure and Promotion". Final Report of the ASA Subcommittee on the Evaluation of Social Media and Public Communication in Sociology. Unter Mitarbeit von Leslie McCall, Gabriel Hetland, Arne Kalleberg, Alondra Nelson, Sarah Ovink, Amy Schalet et al. American Sociological Association. Available online at www.asanet.org/sites/default/files/tf_report_what_counts_evaluating_public_communication_in_tenure_and_promotion_final_august_2016.pdf, accessed on 06.03.2017.

Anderson, Ashley A.; Brossard, Dominique; Scheufele, Dietram A.; Xenos, Michael A.; Ladwig, Peter (2014): The "Nasty Effect:" Online Incivility and Risk Perceptions of Emerging Technologies. In: Journal of Computer-Mediated Communication 19 (3), 373–387. DOI: 10.1111/jcc4.12009.

Anderson, Chris (2004): The Long Tail. In: Wired 12 (10), 170–177. Available online at https://www.wired.com/2004/10/tail/, accessed on 06.03.2017.

ARD/ZDF (2015): ARD/ZDF-Onlinestudie 2015. ARD/ZDF-Medienkommission (ARD/ZDF-Onlinestudie). Available online at http://www.ard-zdf-onlinestudie.de/, accessed on 06.03.2017.

Baecker, Dirk (2007): Studien zur nächsten Gesellschaft. 1st Edition. Frankfurt am Main: Suhrkamp.

Bauer, Martin; Bucchi, Massimiano (Eds.) (2010): Journalism, Science and Society. Science Communication between News and Public Relations. Digit. print. New York: Routledge (Routledge studies in science, technology and society, 7).

Bauer, Martin W. (2013): The Knowledge Society Favours Science Communication, but Puts Science Journalism into a Clinch. In: Patrick Baranger und Bernard Schiele (Eds.): Science Communication Today. International Perspectives, Issues and Strategies; Journées Hubert Curien de la Culture Scientifique, Technique et Industrielle, Nancy, 2012. Paris: CNRS Editions, 145–166.

Beck, Klaus; Dogruel, Leyla (2016): Ökonomische Perspektiven des Wissenschaftsjournalismus und der Wissenschaftskommunikation. Expertise für die Akademien-Arbeitsgruppe. Available online: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Projekte/Laufende_Projekte/WOEM2/Expertise_Beck_und_Dogruel_Entwurf.pdf, accessed 06.03.2017.

Bell, Emily (2016): Facebook is eating the world. In: Columbia Journalism Review, 07.03.2017. Availabel online at https://www.cjr.org/analysis/facebook_and_media.php, accessed on 23.05.2017.

Benkler, Yochai; Nissenbaum, Helen (2006): Commons-based Peer Production and Virtue. In: The Journal of Political Philosophy 14(4), 394-419.

Bessi, Alessandro; Ferrara, Emilio (2016): Social Bots Distort the 2016 U.S. Presidential Election Online Discussion. In: First Monday 21 (11). DOI: 10.5210/fm.v21i11.7090.

Betsch, Cornelia; Renkewitz, Frank; Betsch, Tilmann; Ulshofer, Corina (2010): The Influence of Vaccine-Critical Websites on Perceiving Vaccination Risks. In: Journal of Health Psychology 15 (3), 446–455. DOI: 10.1177/1359105309353647.

Blattmann, Heidi; Jarren, Otfried; Schnabel, Ulrich; Weingart, Peter; Wormer, Holger (2014): Kontrolle durch Öffentlichkeit. Zum Verhältnis Medien–Wissenschaft in der Demokratie. In: Peter Weingart und Patricia Schulz (Eds.): Wissen – Nachricht – Sensation. Zur Kommunikation zwischen Wissenschaft, Öffentlichkeit und Medien. 1. Auflage. Weilerswist: Velbrück Wiss, 391–412.

Blöbaum, Bernd et al. (2016): Trust and Communication in a Digitized World. Models and Concepts of Trust Research. Heidelberg et al.: Springer.

Boie, Johannes (2016): Unerhört. In: Süddeutsche Zeitung, 08.11.2016. Available online at http://www.sueddeutsche.de/politik/manipulation-unerhoert-1.3238198, accessed 06.03.2017.

Bonfadelli, H.; Fähnrich, B.; Lüthje, C.; Milde, J.; Rhomberg, M.; Schäfer, M. S. (Eds.): Forschungsfeld Wissenschaftskommunikation, Springer VS 2016.

Bright, Jonathan (2016): Explaining the Emergence of Echo Chambers on Social Media: the Role of Ideology and Extremism. Available online at https://arxiv.org/abs/1609.05003, accessed 06.03.2017.

Brossard, Dominique (2013): New Media Landscapes and the Science Information Consumer. In: Proceedings of the National Academy of Sciences of the United States of America 110 Suppl 3, 14096–14101. DOI: 10.1073/pnas.1212744110.

Brossard, Dominique; Scheufele, Dietram A. (2013a): Social Science. Science, New Media, and the Public. In: Science (New York, N.Y.) 339 (6115), 40–41. DOI: 10.1126/science.1232329.

Brossard, Dominique; Scheufele, Dietram A. (2013b): This Story Stinks. In: The New York Times, 02.03.2013, 5. Available online at http://www.nytimes.com/2013/03/03/opinion/sunday/this-story-stinks.html?_r=1, accessed 06.03.2017.

Bruns, Axel (2017 [in E.]): Das Modell The Conversation: 'Academic Rigour, Journalistic Flair'. In: Peter Weingart, Holger Wormer, Andreas Wenninger und Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

BMBF/Federal Ministry of Education and Research (2016): Fünf Konsortien erarbeiten Konzept für Deutsches Internet-Institut. Available online at https://www.bmbf.de/de/fuenf-konsortien-erarbeiten-konzept-fuer-deutsches-internet-institut-2947.html, accessed 06.03.2017.

Bundesverband Deutscher Stiftungen (2015): Aufruf: Stiftungen für Qualitätsjournalismus. Available online at https://www.stiftungen.org/de/presse/pressemitteilungen/archiv-pressemitteilungen/pressemitteilungen-dynamische-inhalte/detailseite-pressemitteilung/mode/teaserstart/detail/5857.html, accessed 06.03.2017.

Bundesverband Hochschulkommunikation (2015): Leitlinien zur guten Wissenschafts-PR. Available online at http://www.bundesverband-hochschulkommunikation.de/verband/arbeitskreise/iq-hkom/iq-leitlinien/, accessed 06.03.2017.

Bund-Länder-Kommission (2016): Bericht der Bund-Länder-Kommission zur Medienkonvergenz. Bund-Länder-Kommission. Available online at https://www.bundesregierung.de/Content/DE/_Anlagen/BKM/2016/2016-06-14-medienkonvergenz-bericht-blk.pdf;jsessionid=1DD1ABE61F970713F11C980FD2DC566D.s7t1?__blob=publicationFile&v=3, accessed 06.03.2017.

Butler, Linda (2010): Impacts of Performance-Based Research Funding Systems: A Review of the Concerns and the Evidence. In: Performance-Based Funding for Public Research in Tertiary Education Institutions, OECD (Eds.), 127–166.

Charisius, Hanno (2016): Bedingt vertrauenswürdig. In: Süddeutsche Zeitung, 09.07.2016 (157), 37.

Davis, Jenny L. (2016): Curation. A Theoretical Treatment. In: Information, Communication & Society, 1–14. DOI: 10.1080/1369118X.2016.1203972.

Decker, Frank; Lewandowsky, Marcel; Solar, Marcel (2013): Demokratie ohne Wähler? Neue Herausforderungen der politischen Partizipation. Bonn: Dietz.

Deutscher Bundestag. Ausschuss für Bildung, Forschung und Technikfolgenabschätzung (2015): Öffentliches Fachgespräch zum Thema „Stand und Perspektiven der Wissenschaftskommunikation". Deutscher Bundestag. Ausschuss für Bildung, Forschung und Technikfolgenabschätzung. Available online at http://www.bundestag.de/ausschuesse18/a18/fg-wissenschaftskommunikation/391290, accessed 06.03.2017.

Deutsche Universitätszeitung (2014): Erklären Sie noch oder werben Sie schon? Wissenschaft diskutiert Standards für die Kommunikation mit der Öffentlichkeit, No. 7, 24–37.

Del Vicario, M. et al. (2015): The Spreading of Misinformation Online, Proceedings of the National Academy of Sciences (PNAS). Available online at: http://www.pnas.org/content/113/3/554, accessed 06.03.2017.

De Ridder, Daniela (2017 [in E.]): Vorwort. In: Peter Weingart, Holger Wormer, Andreas Wenninger und Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Di Fabio, Udo (2016): Die algorithmische Person. In: Frankfurter Allgemeine Zeitung, 31.05.2016 (124), 13. Available online at http://www.faz.net/aktuell/feuilleton/debatten/der-staat-muss-die-grundrechte-in-der-digitalen-welt-sichern-14260564.html?printPagedArticle=true#pageIndex_2, accessed 06.03.2017.

Dogruel, Leyla; Beck, Klaus (2017 [in E.]): Social Media als Alternative der Wissenschaftskommunikation? Eine medienökonomische Analyse. In: Peter Weingart, Holger Wormer, Andreas Wenninger und Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Dönges, Jan: 20 Prozent aller Wahltweets stammten von Bots. Available online at http://www.spektrum.de/news/20-prozent-aller-wahltweets-stammten-von-bots/1429117, accessed 06.03.2017.

Dörr, Dieter; Holznagel, Bernd; Picot, Arnold (2016): Legitimation und Auftrag des öffentlich-rechtlichen Fernsehens in Zeiten der Cloud. Zweites Deutsches Fernsehen. Available online at http://www.zdf.de/ZDF/zdfportal/blob/45517114/5/data.pdf, accessed 06.03.2017.

Ebersbach, Anja; Glaser, Markus; Heigl, Richard (2016): Social Web. 3rd revised Edition. Constance, Munich: UVK Verlagsgesellschaft GmbH; UVK/Lucius (utb, 3065).

Edelman (2016): 2016 Edelman Trust Barometer: Executive Summary. Available online at http://www.edelman.com/insights/intellectual-property/2016-edelman-trust-barometer/executive-summary/, accessed 06.03.2017.

Ellis, Justin (2015): What Happened after 7 News Sites Got Rid of Reader Comments. Ed. by Nieman Lab. Available online at http://www.niemanlab.org/2015/09/what-happened-after-7-news-sites-got-rid-of-reader-comments/, last updated 16.09.2015, accessed 06.03.2017.

Ethority (2016): Social Media Prisma German Edition – Version 6. Available online at http://ethority.de/social-media-prisma/, accessed 06.03.2017.

Fischhoff, Baruch; Scheufele, Dietram A. (2013): The Science of Science Communication. Introduction. In: Proceedings of the National Academy of Sciences of the United States of America 110 Suppl 3, 14031–14032. DOI: 10.1073/pnas.1312080110.

Fischhoff, Baruch; Scheufele, Dietram A. (2014): The Science of Science Communication II. In: Proceedings of the National Academy of Sciences of the United States of America 111 Suppl 4, 13583–13584. DOI: 10.1073/pnas.1414635111.

Flaxman, Seth; Goel, Sharad; Rao, Justin M. (2016): Filter Bubbles, Echo Chambers, and Online News Consumption. In: PUBOPQ 80 (S1), 298–320. DOI: 10.1093/poq/nfw006.

Fleischhauer, Jan (2016): Staatsanwälte ermitteln gegen Mark Zuckerberg. Available online at www.spiegel.de/netzwelt/web/facebook-staatsanwaltschaft-ermittelt-gegen-mark-zuckerberg-a-1119746.html, published 04.11.2016, accessed 06.03.2017.

Fotopoulou, Aristea; Couldry, Nick (2014): Telling the Story of the Stories. Online Content Curation and Digital Engagement. In: Information, Communication & Society 18 (2), 235–249. DOI: 10.1080/1369118X.2014.952317.

Franzen, Martina (2015): Der Impact Faktor war gestern. Altmetrics und die Zukunft der Wissenschaft. In: Soziale Welt 66 (2), 225–242. DOI: 10.5771/0038-6073-2015-2-225.

Frees, Beate; Koch, Wolfgang (2015): Internetnutzung: Frequenz und Vielfalt nehmen in allen Altersgruppen zu. In: Media Perspektiven 9, 366–377. Available online at http://www.ard-zdf-onlinestudie.de/fileadmin/Onlinestudie_2015/0915_Frees_Koch.pdf, accessed 06.03.2017.

Garrett, R. Kelly (2009): Echo Chambers Online? Politically Motivated Selective Exposure among Internet News Users. In: Journal of Computer-Mediated Communication 14 (2), 265–285. DOI: 10.1111/j.1083-6101.2009.01440.x.

Gennis, Martin; Gundlach, Hardy (2014): Wer sind die Gatekeeper der Konvergenzmedien. Kriterien und Bestimmung vorherrschender Meinungsmacht in konvergenten Medienumgebungen. In: Media Perspektiven (10), 507–524. Available online at http://www.ard-werbung.de/fileadmin/user_upload/media-perspektiven/pdf/2014/10-2014_Gennis_Gundlach.pdf, accessed 06.03.2017.

Gerhards, Jürgen; Schäfer, Mike Steffen (2006): Die Herstellung einer öffentlichen Hegemonie. Humangenomforschung in der deutschen und der US-amerikanischen Presse. Wiesbaden: VS Verlag für Sozialwissenschaften | GWV Fachverlage GmbH Wiesbaden.

Gigerenzer, Gerd; Mata, Jutta; Frank, Ronald (2009): Public Knowledge of Benefits of Breast and Prostate Cancer Screening in Europe. In: Journal of the National Cancer Institute 101 (17), 1216–1220. DOI: 10.1093/jnci/djp237.

Gross, Liza (2009): A Broken Trust: Lessons from the Vaccine-Autism Wars. In: PLoS biology 7 (5), e1000114. DOI: 10.1371/journal.pbio.1000114.

Haas, Florian (2016): Die Klarmacher. Bayerischer Rundfunk. Available online at http://www.br.de/nachrichten/inhalt/br-medienstudie-klarmacher100.html, published 02.05.2016, accessed 06.03.2017.

Haas, Florian (2016): Wie glaubwürdig sind die Medien? BR-Medienstudie „Informationen fürs Leben“. Bayerischer Rundfunk. Available online at http://www.br.de/nachrichten/inhalt/br-medien-studie-100.html, published 02.05.2016, accessed 06.03.2017.

Hagenhoff, Svenja; Seidenfaden, Lutz; Ortelbach, Björn; Schumann, Matthias (2007): Neue Formen der Wissenschaftskommunikation. Eine Fallstudienuntersuchung. Göttingen: Univ.-Verl. Göttingen; Niedersächsische Staats- und Universitätsbibliothek (Göttinger Schriften zur Internetforschung, 4). Available online at http://www.univerlag.uni-goettingen.de/bitstream/handle/3/isbn-978-3-938616-75-8/fallstudien_wikom.pdf?sequence=1, accessed 06.03.2017.

Hampel, Jürgen (Ed.) (1999): Gentechnik in der Öffentlichkeit. Wahrnehmung und Bewertung einer umstrittenen Technologie. Frankfurt: Campus-Verl.

Hampton, K. N.; Rainie, L.; Lu, W.; Dwyer, M.; Shin, I.; Purcell, K. (2014): “Social Media and the ‘Spiral of Silence’”. Pew Research Center, Washington, D. C. Available online at http://www.pewinternet.org/2014/08/26/social-media-and-the-spiral-of-silence/, accessed 06.03.2017.

Helbing, Dirk; Frey, Bruno S.; Gigerenzer, Gerd; Hafen, Ernst; Hagner, Michael; Hofstetter, Yvonne et al. (2016): Digitale Demokratie statt Datendiktatur. In: Spektrum der Wissenschaft, 2016 (1), 50–58. Available online at http://www.spektrum.de/news/wie-algorithmen-und-big-data-unsere-zukunft-bestimmen/1375933, accessed 06.03.2017.

Hillje, Johannes (2016): Massenspaltungsmedium. In: Frankfurter Allgemeine Sonntagszeitung, 13.11.2016 (45), 10.

Hochschulrektorenkonferenz (2013): Wissenstransfer in die Mediengesellschaft: Situationsanalyse und Orientierungshilfen. Entschließung der 14. Mitgliederversammlung der HRK am 14. Mai 2013 in Nürnberg. Hochschulrektorenkonferenz. Nuremberg. Available online at https://www.hrk.de/uploads/tx_szconvention/Entschliessung_Wissenstransfer_Gremienpapier_14052013_docx.pdf, accessed 25.10.2016.

Hollmer, Kathrin (2015): Einmal Kurator sein. In: Süddeutsche Zeitung, 21.12.2015 (294), 23. Available online at http://www.sueddeutsche.de/medien/digitaler-journalismus-einmal-kurator-sein-1.2790827, accessed 06.03.2017.

Howard, Philip N.; Kollanyi, Bence (2016): Bots, #StrongerIn, and #Brexit: Computational Propaganda during the UK-EU Referendum. Cornell University Library. Available online at https://arxiv.org/abs/1606.06356, accessed 06.03.2017.

Infratest dimap (2016): Glaubwürdigkeit der Medien – Auftraggeber: WDR. Available online at http://www.infratest-dimap.de/umfragen-analysen/bundesweit/umfragen/aktuell/glaubwuerdigkeit-der-medien/, accessed 06.03.2017.

Initiative Qualität von Hochschulkommunikation (IQ_HKom) (2016): Leitlinien zur guten Wissenschafts-PR. Bundesverband Hochschulkommunikation; Wissenschaft im Dialog. Available online at http://www.bundesverband-hochschulkommunikation.de/verband/arbeitskreise/iq-hkom/iq-leitlinien/, accessed 06.03.2017.

Institut für Demoskopie Allensbach (2013): Hohes Ansehen für Ärzte und Lehrer – Reputation von Hochschulprofessoren und Rechtsanwälten rückläufig. Allensbacher Berufsprestige-Skala 2013. Institut für Demoskopie Allensbach. Allensbach (Allensbacher Kurzbericht – 20th August 2013).

Irwin, Alan; Wynne, Brian (Eds.) (1996): Misunderstanding Science? The Public Reconstruction of Science and Technology. 1. publ. Cambridge [et al.]: Cambridge Univ. Press.

Isaac, Mike (2016): Facebook Considering Ways to Combat Fake News, Mark Zuckerberg Says. In: The New York Times, 19.11.2016. Available online at https://www.nytimes.com/2016/11/20/business/media/facebook-considering-ways-to-combat-fake-news-mark-zuckerberg-says.html?_r=2, accessed 09.02.2017.

Jackob, Nikolaus; Quiring, Oliver; Schemer, Christian; Schultz, Tanjev; Ziegele, Marc (2017): Vertrauenskrise in den Medien untersucht. In: European Journalism Observatory, 28.01.2017. Available online at http://de.ejo-online.eu/qualitaet-ethik/17587, accessed 06.03.2017.

Jarren, Otfried (2008): Massenmedien als Intermediäre. Zur anhaltenden Relevanz der Massenmedien für die öffentliche Kommunikation. In: Medien & Kommunikationswissenschaft 56 (3-4), 329–346.

Jarren, Otfried (2016): Darüber redet man lieber nicht. Die Medienbranche und die Qualitätsfrage. In: Neue Züricher Zeitung, 24.09.2016. Available online at http://www.nzz.ch/feuilleton/medien/die-medienbranche-und-die-qualitaetsfrage-darueber-redet-man-lieber-nicht-ld.118481, accessed 06.03.2017.

Jasanoff, Sheila; Hurlbut, J. Benjamin; Saha, Krishanu (2015): CRISPR Democracy: Gene Editing and the Need for Inclusive Deliberation. In: Issues in Science and Technology 32 (1), 25–32.

Kohring, Matthias (1997): Die Funktion des Wissenschaftsjournalismus. Ein systemtheoretischer Entwurf. Wiesbaden: VS Verlag für Sozialwissenschaften (Studien zur Kommunikationswissenschaft, 22).

Kohring, Matthias (2004): Vertrauen in Journalismus. Theorie und Empirie. Constance: UVK.

Kohring, Matthias (2005): Wissenschaftsjournalismus. Forschungsüberblick und Theorieentwurf. Constance: UVK.

Kroll, Lars (2015): JIM-Studie 2015 – Jugendliche im digitalen Zeitalter. Available online at http://socialmedia-institute.com/jim-studie-2015-jugendliche-digitalen-zeitalter/, accessed 06.03.2017.

Kuhn, Johannes; Hauck, Mirjam (2012): Ausweitung der Komfortzone. Eli Pariser und die „Filter Bubble“. In: Süddeutsche Zeitung, 08.03.2012. Available online at http://www.sueddeutsche.de/digital/eli-pariser-und-die-filter-bubble-ausweitung-der-komfortzone-1.1303419, accessed 06.03.2017.

LaBarre, Suzanne (2013): Why We’re Shutting off Our Comments. Starting Today, Popularscience.com Will No Longer Accept Comments on New Articles. Here’s Why. In: Popular Science. Available online at http://www.popsci.com/science/article/2013-09/why-were-shutting-our-comments, accessed 06.03.2017.

Landtag NRW (2017): Anhörung des Ausschusses für Kultur und Medien. Available online at https://www.landtag.nrw.de/portal/WWW/GB_I/I.1/Ausschuesse/A12_-_Ausschuss_fuer_Kultur_und_Medien/Anhoerungen.jsp, accessed 06.03.2017.

Landtag Nordrhein-Westfalen (2017): Entschließungsantrag der Fraktion der SPD und der Fraktion BÜNDNIS 90/DIE GRÜNEN, 17.01.2017. Available online at https://www.landtag.nrw.de/Dokumentenservice/portal/WWW/dokumentenarchiv/Dokument/MMD16-14019.pdf, accessed 06.03.2017.

Leshner, Alan I. (2003): Public Engagement with Science. In: Science (New York, N.Y.) 299 (5609), 977. DOI: 10.1126/science.299.5609.977.

Leßmöllmann, Annette (2012): Social Media: die neue Öffentlichkeit. In: Beatrice Dernbach, Christian Kleinert and Herbert Münder (Eds.): Handbuch Wissenschaftskommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften, 251–257.

Lewandowsky, Stephan; Ecker, Ullrich K. H.; Seifert, Colleen M.; Schwarz, Norbert; Cook, John (2012): Misinformation and Its Correction: Continued Influence and Successful Debiasing. In: Psychological Science in the Public Interest: A Journal of the American Psychological Society 13 (3), 106–131. DOI: 10.1177/1529100612451018.

Liang, X.; Su, L. Y.-F.; Yeo, S. K.; Scheufele, D. A.; Brossard, D.; Xenos, M. et al. (2014): Building Buzz. (Scientists) Communicating Science in New Media Environments. In: Journalism & Mass Communication Quarterly 91 (4), 772–791. DOI: 10.1177/1077699014550092.

Lilienthal, Volker (2016): „Geschlossenes Universum“. Volker Lilienthal über die Kolonisierung des Journalismus. In: epd medien, 7–13.

Lobe, Adrian (2016): Meinung aus dem Bot. In: DIE ZEIT 46, 03.11.2016, 49.

Lobigs, Frank (2016): „Digitale Mega-Gewinner“. Frank Lobigs‘ Thesen zur Zukunft des Journalismus. In: epd medien, S. 27.

Lobin, Henning (2016): Soziale Medien in der Wissenschaftskommunikation – der Status Quo. In: Wissenschaftskommunikation3 (Blog), 22.02.2016. Available online at http://scilogs.spektrum.de/Wissenschaftskommunikation-hoch-drei/soziale-medien-wissenschaftskommunikation-status-quo/, accessed 06.03.2017.

Lobin, Henning (2017 [i. E.]): Aktuelle und künftige technische Rahmenbedingungen digitaler Medien für die Wissenschaftskommunikation. In: Peter Weingart, Holger Wormer, Andreas Wenninger and Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Lobo, Sascha (2016): Hilferuf an die mindestens durchschnittlich Begabten. Spiegel Online, 20.01.2016. Available online at http://www.spiegel.de/netzwelt/web/lobo-kolumne-hilferuf-an-die-mindestens-durchschnittlich-begabten-a-1072955.html, accessed 06.03.2017.

McChesney, Robert W. (2014): Be Realistic, Demand the Impossible. Three Radically Democratic Internet Policies. In: Critical Studies in Media Communication 31 (2), 92–99. DOI: 10.1080/15295036.2014.913806.

McKeever, Brooke Weberling; McKeever, Robert; Holton, Avery E.; Li, Jo-Yun (2016): Silent Majority. Childhood Vaccinations and Antecedents to Communicative Action. In: Mass Communication and Society 19 (4), 476–498. DOI: 10.1080/15205436.2016.1148172.

Medienpädagogischer Forschungsverbund Südwest (mpfs) (2015): Jugend, Information, (Multi-)Media. Basisstudie zum Medienumgang 12- bis 19-Jähriger in Deutschland. With participation of Peter Behrens and Thomas Rathgeb. Ed. by Medienpädagogischer Forschungsverbund Südwest (mpfs). Stuttgart. Available online at http://www.mpfs.de/fileadmin/files/Studien/JIM/2015/JIM_Studie_2015.pdf, accessed 06.03.2017.

Meedia Redaktion (2016): Lügenpresse-Studie des BR: 60 Prozent der Bevölkerung glauben, dass Medien nicht unabhängig sind, 02.05.2016. Available online at http://meedia.de/2016/05/02/luegenpresse-studie-des-br-60-prozent-der-bevoelkerung-glauben-dass-medien-nicht-unabhaengig-sind/, accessed 06.03.2017.

Meier, Klaus (2013): Wer vertraut den Medien? Nitro – Magazin Berliner Journalisten, 3, 96-97.

Meier, Klaus; Reimer, Julius (2011): Transparenz im Journalismus. Instrumente, Konfliktpotentiale, Wirkung. In: Publizistik, 56. Jg., H.2, 133–155.

Meyer-Guckel (2012): Marketing oder Kommunikation? Wie die Wissenschaft kommunizieren sollte Teil 2. Ed. by Reiner Korbmann. Science & Media Büro für Wissenschafts- und Technikkommunikation (Wissenschaft kommuniziert (Blog), 27.12.2012). Available online at https://wissenschaftkommuniziert.wordpress.com/2012/09/27/marketing-oder-kommunikation-wie-wissenschaft-kommunizieren-sollte-teil-2/, accessed 06.03.2017.

Michal, Wolfgang (2016): Wie das „Kuratieren" den Journalismus verändert, 02.02.2015. Available online at http://www.wolfgangmichal.de/2015/02/wie-das-kuratieren-den-journalismus-veraendert/, accessed 06.03.2017.

Milkman, Katherine L.; Berger, Jonah (2014): The Science of Sharing and the Sharing of Science. In: Proceedings of the National Academy of Sciences of the United States of America 111 Suppl 4, 13642–13649. DOI: 10.1073/pnas.1317511111.

Müller, Jan (2013): Mechanisms of Trust. News Media in Democratic and Authoritarian Regimes. Frankfurt/New York: Campus.

National Academies of Sciences, Engineering, and Medicine (2016): Communicating Science Effectively: A Research Agenda. Washington, D. C.: The National Academies Press. DOI: 10.17226/23674.

National Science Board (2016): Science & Engineering Indicators 2016. National Science Foundation (Science & Engineering Indicators). Available online at https://www.nsf.gov/statistics/2016/nsb20161/#/, accessed 06.03.2017.

Neuberger, Christoph (2014): Social Media in der Wissenschaftsöffentlichkeit. Forschungsstand und Empfehlungen. In: Peter Weingart und Patricia Schulz (Eds.): Wissen – Nachricht – Sensation. Zur Kommunikation zwischen Wissenschaft, Öffentlichkeit und Medien. 1. Auflage. Weilerswist: Velbrück Wiss, 315–368. Available online at http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Projekte/Abgeschlossene_Projekte/WOEM/Neuberger_aus_Weingart_Schulz_Wissen_Nachricht_Sensation.pdf, accessed 06.03.2017.

Nisbet, Matthew C.; Brossard, Dominique; Kroepsch, Adrianne (2003): Framing Science. The Stem Cell Controversy in an Age of Press Politics. In: harv int j press/pol 8 (2), 36–70. DOI: 10.1177/1081180X02251047.

Osel, Johann (2015): Prof. Dr. Twitter-Muffel. sueddeutsche.de, 19.08.2015. Available online at http://www.sueddeutsche.de/politik/wissenschaftler-prof-twitter-muffel-1.2612211, accessed 06.03.2017.

Pew Research Center (2015): Beyond Distrust: How Americans View Their Government. Broad Criticism, but Positive Performance Ratings in Many Areas. Pew Research Center, 23.11.2015. Available online at http://www.people-press.org/2015/11/23/beyond-distrust-how-americans-view-their-government/, accessed 06.03.2017.

Pickard, Victor (2015): Conclusion: Confronting Market Failure. America's Battle for Media Democracy: The Triumph of Corporate Libertarianism and the Future of Media Reform, 212–231. Available online at http://repository.upenn.edu/asc_papers/420, accessed 06.03.2017.

Praschl, Peter (2016): Macht Facebook den Journalismus groß oder kaputt?. In: Die Welt, 14.03.2016. Available online at https://www.welt.de/kultur/literarischewelt/article153241717/Macht-Facebook-den-Journalismus-gross-oder-kaputt.html, accessed 06.03.2017.

Pscheida, D. et al. (2014): Nutzung von Social Media und onlinebasierten Anwendungen in der Wissenschaft. Ergebnisse des Science 2.0-Survey 2014. Science 2.0 Leibniz Forschungsverbund. http://www.qucosa.de/fileadmin/data/qucosa/documents/16313/Science20_Datenreport_2014_PDF_A.indd.pdf, accessed 06.03.2017.

Ranger, Mathieu; Bultitude, Karen (2016): 'The kind of mildly curious sort of science interested person like me': Science bloggers' practices relating to audience recruitment. In: Public Understanding of Science 25 (3), 361–378. DOI: 10.1177/0963662514555054.

Reinemann, Carsten; Fawzi, Nayla (2016): Eine vergebliche Suche nach der Lügenpresse. Analyse von Langzeitdaten. In: Der Tagesspiegel, 24.01.2016. Available online at http://www.tagesspiegel.de/politik/analyse-von-langzeitdaten-eine-vergebliche-suche-nach-der-luegenpresse/12870672-all.html, accessed 06.03.2017.

Reinemann, Carsten (2016): Die ‚Vertrauenskrise' der deutschen Medien – Fakt oder Fiktion?. In: 11. dbb Medienkonferenz unter dem Motto „Reformdruck, Sparzwang, Glaubwürdigkeitsproblem". Available online at http://www.dbb.de/teaserdetail/artikel/oeffentlich-rechtlicher-rundfunk-bleibt-unverzichtbar.html, accessed 06.03.2017.

Retraction Watch (2015a): Retraction Watch Tracking Retractions as a Window into the Scientific Process Half of Anesthesiology Fraudster's Papers Continue to Be Cited Years after Retractions. Available online at http://retractionwatch.com/2015/07/14/half-of-anesthesiology-fraudsters-papers-continue-to-be-cited-years-after-retractions/, veröffentlicht am 14.07.2015, accessed 06.03.2017.

Retraction Watch (2015b): Top 10 Most Highly Cited Retracted Papers Continue to Be Cited Years after Retractions. Available online at http://retractionwatch.com/the-retraction-watch-leaderboard/top-10-most-highly-cited-retracted-papers/, veröffentlicht am 28.12.2015, accessed 06.03.2017.

Reuters Institute (2016): Digital-News-Report. Available online at http://po.st/pkDNSZ, accessed 06.03.2017.

Riesmeyer, Claudia (2014): Von Macht und Ohnmacht. Das Verhältnis zwischen Journalisten und Pressesprechern aus akteurstheoretischer Perspektive. In: Birgit Stark, Oliver Quiring and Nikolaus Jackob (Eds.): Von der Gutenberg-Galaxis zur Google-Galaxis. Alte und neue Grenzvermessungen nach 50 Jahren DGPuK. Constance: UVK Verl.-Ges (Schriftenreihe der Deutschen Gesellschaft für Publizistik- und Kommunikationswissenschaft, 41), 289–308.

Roll, Evely (2016): Die Lüge. Was bedeutet es für die Politik, wenn Fakten nicht mehr zählen? Überlegungen zum Wahljahr 2017. In: Süddeutsche Zeitung, 19.11.2016, 49.

Rowe, Gene; Frewer, Lynn J. (2005): A Typology of Public Engagement Mechanisms. In: Science, Technology & Human Values 30 (2), 251–290. DOI: 10.1177/0162243904271724.

Ruß-Mohl, Stephan (2015): Ohnmächtige Helden der vierten Gewalt. In: Neue Züricher Zeitung, 30.06.2015. Available online at https://www.nzz.ch/feuilleton/medien/ohnmaechtige-helden-der-vierten-gewalt-1.18570895, accessed 06.03.2017Sauerbrey, Anna (2016): WÖM2-Workshop „Bedeutung, Chancen und Risiken der sozialen Medien für die Wissenschaftskommunikation“. Available online at: https://www.youtube.com/watch?v=3blrT4JWY-Y&feature=youtu.be, veröffentlicht am 18.03.2016, accessed 06.03.2017.

Schäfer, Mike S. (2016): Mediated Trust in Science: Concept, Measurement and Perspectives for the ‘Science of Science Communication’. In: Journal of Science Communication 15 (05, C02). Available online at https://jcom.sissa.it/sites/default/files/documents/JCOM_1505_2016_C02.pdf, accessed 06.03.2017.

Schäfer, Mike S.; Kristiansen, Silje; Bonfadelli, Heinz (Eds.) (2015): Wissenschaftskommunikation im Wandel. Neue Ausgabe. Cologne: Herbert von Halem Verlag.

Scheufele, Dietram A. (2014): Science Communication as Political Communication. In: Proceedings of the National Academy of Sciences of the United States of America 111 Suppl 4, 13585–13592. DOI: 10.1073/pnas.1317516111.

Schmidt, Jan-Hinrik (2013): Social Media. Wiesbaden: Springer Verlag.

Schmidt, Jan-Hinrik (2016): Wissenschaftskommunikation unter sozialmedialen Bedingungen (Teil 4). In: Wissenschaftskommunikation3 (Blog), 19.02.2016. Available online http://scilogs.spektrum.de/Wissenschaftskommunikation-hoch-drei/wissenschaftskommunikation-unter-sozialmedialen-bedingungen-teil-4/, accessed 06.03.2017.

Schmidt, Jan-Hinrik (2017 [i. E.]): Soziale Medien als Intermediäre in der Wissenschaftskommunikation. In: Peter Weingart, Holger Wormer, Andreas Wenninger and Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Schraven, David (2015): Stellungnahme, 06.02.2015. Available online at www.landtag.nrw.de/portal/WWW/dokumentenarchiv/Dokument?Id=MMST16/2584, accessed 06.03.2017.

Schweizer Jugendbarometer (2016): Generation Stress?. Available online at https://www.credit-suisse.com/ch/de/about-us/responsibility/dialogue/youth-barometer.html, accessed 06.03.2017.

Serong, Julia; Koppers, Lars; Luschmann, Edith; Molina Ramirez, Alejandro; Kersting, Kristian; Rahnenführer, Jörg; Wormer, Holger (2017): Öffentlichkeitsorientierung von Wissenschaftsinstitutionen und Wissenschaftsdisziplinen. In: Publizistik 62 (2), 153–178. DOI: 10.1007/s11616-017-0336-6.

Spiewak, Martin (2017): “Hingehen, wo es brodelt und stinkt”. In: DIE ZEIT No. 5, 26.01.2017. Available online at http://www.zeit.de/2017/05/medien-vertrauen-umfrage-ifak/komplettansicht, accessed 06.03.2017.

Stanford History Education Group (2016): From History Assessments to Assessments of News Literacy, Final Report.

Stirn, Alexander (2010): In eigener Sache: Warum ich ScienceBlogs verlasse. Alles was fliegt (ScienceBlogs.de), 29.10.2010. Available online at http://scienceblogs.de/alles-was-fliegt/2010/10/29/in-eigener-sache-warum-ich-scienceblogs-verlasse/?all=1, accessed 06.03.2017.

Sullivan, Andrew (2016): Democracies End when They Are too Democratic. And Right Now, America Is a Breeding Ground for Tyranny. In: New York Magazine, 02.05.2016. Available online at http://nymag.com/daily/intelligencer/2016/04/america-tyranny-donald-trump.html, accessed 06.03.2017.

Tett, Gillian (2016): Why We No Longer Trust the Experts. In: Financial Times, 01.07.2016. Available online at https://www.ft.com/content/24035fc2-3e45-11e6-9f2c-36b487ebd80a, accessed 06.03.2017.

The Coral Project (2016): Shutting Down onsite Comments: A Comprehensive List of All News Organisations. Available online at https://community.coralproject.net/t/shutting-down-onsite-comments-a-comprehensive-list-of-all-news-organisations/347, accessed 06.03.2017.

Thiel, Thomas (2016): Die politische Räson des Internets. In: Frankfurter Allgemeine Zeitung, 01.10.2016 (230), 11. Available online at http://www.faz.net/aktuell/feuilleton/internet-und-demokratie-1-die-politische-raeson-der-neuen-medien-14461212.html?printPagedArticle=true#pageIndex_2, accessed 06.03.2017.

Tippelt, Florian; Kupferschmitt, Thomas (2015): Social Web: Ausdifferenzierung der Nutzung – Potenziale für Medienanbieter. [ARD/ZDF-Onlinestudie 2015]. In: Media Perspektiven 10, 442–452. Available online at http://www.ard-zdf-onlinestudie.de/fileadmin/Onlinestudie_2015/10-15_Tippelt_Kupferschmitt.pdf, accessed 06.03.2017.

Twenge, Jean M.; Campbell, W. Keith; Carter, Nathan T. (2014): Declines in Trust in Others and Confidence in Institutions among American Adults and Late Adolescents, 1972–2012. In: Psychological Science 25 (10), 1914–1923. DOI: 10.1177/0956797614545133.

Van Noorden, Richard (2014), Scientists and the Social Network, Nature, Vol. 512, 125–129.

VolkswagenStiftung (2015): Dokumentation: Workshop Wissenschaftskommunikation. Tagungszentrum Schloss Herrenhausen, 30th June and 1st July 2014. VolkswagenStiftung. Tagungszentrum Schloss Herrenhausen. Available online at https://www.volkswagenstiftung.de/wowk14.html, accessed 06.03.2017.

VolkswagenStiftung (2015): Wissenschaft und Datenjournalismus. Available online at https://www.volkswagenstiftung.de/datenjournalismus.html, accessed 06.03.2017.

Weingart, Peter; Lentsch, Justus (2015): Wissen – Beraten – Entscheiden. Form und Funktion wissenschaftlicher Politikberatung in Deutschland. 2nd Edition. Weilerswist: Velbrück-Wissenschaft (Forschungsberichte / Interdisziplinäre Arbeitsgruppen, Berlin-Brandenburgische Akademie der Wissenschaften, Vol. 22).

Weingart, Peter; Schulz, Patricia (Eds.) (2014): Wissen – Nachricht – Sensation. Zur Kommunikation zwischen Wissenschaft, Öffentlichkeit und Medien. 1st Edition. Weilerswist: Velbrück Wiss.

Weingart, Peter (2012): The Lure of the Mass Media and its Repercussions on Science. In: S. Rödder, M. Franzen & P. Weingart (Eds.): Sociology of the Sciences Yearbook: Vol. 28. The Sciences' Media Connection – Public Communication and its Repercussions (17–34). Dordrecht et al.: Springer.

Weingart, Peter; Wormer, Holger; Wenninger, Andreas; Hüttl, Reinhard (Eds.) (2017 [i. E.]): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Weißkopf, Markus (2015): Arbeitskreis stellt Leitlinien zur guten Wissenschafts-PR vor. Wissenschaft im Dialog, 14.09.2015. Available online at www.wissenschaft-im-dialog.de/trends-themen/blogartikel/beitrag/arbeitskreis-stellt-leitlinien-zur-guten-wissenschafts-pr-vor/, accessed 06.03.2017.

Wikipedia (2016): Wissenschaftskommunikation. Available online at https://de.wikipedia.org/wiki/Wissenschaftskommunikation, accessed 06.03.2017.

Wissenschaft im Dialog/TNS Emnid (2016): Wissenschaftsbarometer 2016. Eine repräsentative Meinungsumfrage. Ed. By Wissenschaft im Dialog gGmbH. Wissenschaft im Dialog/TNS Emnid. Berlin (Wissenschaftsbarometer). Available online at http://www.wissenschaft-im-dialog.de/projekte/wissenschaftsbarometer/, accessed 06.03.2017.

Wissenschaftsrat 2016. Wissens- und Technologietransfer als Gegenstand institutioneller Strategien. Available online at www.wissenschaftsrat.de/download/archiv/5665-16.pdf, accessed 06.03.2017.

World Economic Forum (2013): Global Risks 2013, Eighth Edition, Section 2, Digital Wildfires in a Hyperconnected World. Available online at http://reports.weforum.org/global-risks-2013/risk-case-1/digital-wildfires-in-a-hyperconnected-world/, accessed 06.03.2017.

Wormer, Holger (2017a [i. E.]): Mythos Gatewatching? – Die erhoffte Korrektivfunktion von Social Media im Lichte der „Dementiforschung" [i. E.]. In: Peter Weingart, Holger Wormer, Andreas Wenninger and Reinhard Hüttl (Eds.): Perspektiven der Wissenschaftskommunikation im digitalen Zeitalter. Weilerswist: Velbrück.

Wormer, Holger (2016): Pro-faktisch statt post-faktisch: Wissenschaft und Wissenschafts-PR als Wissensmakler. In: Wissenschaftsmanagement – Zeitschrift für Innovation 5, 32-36. .

Zuiderveen Borgesius, Frederik J.; Trilling, Damian; Möller, Judith; Bodó, Balázs; Vreese, Claes H. de; Helberger, Natali; Internet Policy Review (2016): Should We Worry about Filter Bubbles? Ed. by Alexander von Humboldt Institute for Internet and Society.

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