How Do Researchers Achieve Societal Impact? Results of an Empirical Survey Among Researchers in Germany

Fecher, Benedikt; Hebing, Marcel

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How Do Researchers Achieve Societal Impact?

Results of an Empirical Survey Among Researchers in Germany

Benedikt Fecher

Alexander von Humboldt Institute for Internet and Society, Berlin

Marcel Hebing

Digital Business University of Applied Sciences, Berlin

Abstract

How and under what conditions can academic research contribute to solving societal challenges? So far, research on this topic has focused on questions of impact measurability and the public perception of research, and far less on the question of how researchers themselves assess their societal impact. In the same way that it is important to understand how the public receives research, it is important to better understand how researchers anticipate the public and achieve societal impact in order to draft effective policies. In this article we report the results of an empirical survey among 499 researchers in Germany on their pathways to societal impact, i.e. their attitudes towards impact policies, their societal goals and use of engagement formats. We are able to show that most researchers regard societal engagement as part of their job and are generally in favor of impact evaluation. However, few think that societal impact is a priority at their institution, and fewer think that institutional communication departments reach relevant stakeholders in society. Moreover, we are able to show that impact goals differ greatly between disciplines and organizational types. Based on our results, we give recommendations for a governance of impact that is responsive to epistemic cultures and point towards avenues for further research.

Introduction

Societal Impact in Research Governance

Until the 1970s there was no doubt among policymakers that public investments in research would have a positive societal impact. It was only from the late 1980s onward that researchers were increasingly expected to account for their achievements in the form of evaluation exercises (1–3). Initially, these evaluations concerned the intra-scientific (often bibliometric) impacts; it was only in the last decade that policymakers began to focus more on societal impacts of research and thereby what research brings to the economy, broader society, culture, public administration, health, environment and the overall quality of life (1). Noteworthy examples for the shift towards societal impact in research governance are the Research Excellence Framework in the United Kingdom or the Excellence in Research for Australia Framework (4–6). In the Netherlands, a region with some of the most developed examples of impact governance, the Association of Universities in the Netherlands (VSNU), the Netherlands Organisation for Scientific Research (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW) implemented guidelines for the evaluation and improvement for research, the so-called Standard Evaluation Protocol (SEP). The SEP is used by research institutions to evaluate research units and—besides research quality—focuses strongly on relevance for society (7, 8). Societal impact is also a key component in European research funding (9).

In Germany, where we conducted our survey, there is no comparable evaluation exercise. The topic is, however, prominently discussed: The Federal Ministry of Education and Research has published a policy paper in which it stipulates, among other things, that societal impact must become part of the academic reputation logic (10). In 2020 it has set up a think tank — #FactoryWisskomm — to work out how societal impact can be evaluated. The German Council of Sciences and Humanities, an advisory body to the German Federal Government, called for

“more recognition for knowledge and technology transfer” (11). The German Rectors' Conference, as the umbrella organization of German universities, decided at its General Assembly (14 November 2017) that knowledge transfer is a priority task of universities (12). Prominent German research organizations, such as the Leibniz Association, have addressed the topic in policy papers (13).

Although there is no evaluation exercise in Germany comparable to the REF in the UK, it is evident that the topic has gained momentum in Germany in recent years as well. In the light of complex societal challenges and the further integration of German research bodies into the European Research Area, it can be assumed that societal impact of research will become an even more prominent concern in research governance.

Societal Impact in Research

Long before the first impact agendas were implemented, scholars in the field of science and technology studies critically examined the nature and role of science (as the entirety of all disciplines) in society, flanked with novel concepts of academic knowledge creation such as "Mode 2" (14, 15), "Academic capitalism" (16), "post-normal science" (17) or "Triple Helix" (18). Although these concepts differ in their objectives, they generally assume a scientific value creation that is no longer self-sufficient and is increasingly interwoven with society. These explorations of the role of science in society were primarily theoretical and essayistic in nature.

Later, entire lines of (communication) research dedicated themselves to the publics’ dealings with science, for example, the public understanding or awareness of science (PUS, PAwS), scientific literacy, or more recently the public engagement with science and technology (PEST) (19, 20). In general, research in this area shows a trend away from society as an inactive recipient of knowledge—for example in the so-called “deficit model of science communication”

(21) — towards more complex and interactive forms of knowledge dissemination. A topic that has received considerable attention in recent years is the role of social media in communicating with and about science (22, 23). There is, in our view, still a certain bias in communication studies' preoccupation with the societal impact of research, as it has been primarily concerned with the public as recipients of science in contrast with the science itself.

In scientometrics and bibliometrics, the societal impact has also become a focus of research in recent years (24–28). Here, increased attention has been paid to altmetrics as a form of social media-based impact assessment (27–31). Research in these fields is often confined to questions regarding the measurability of societal impact and less with the social organization of science and society and the epistemic conditions necessary for societal impact to occur.

While there is a considerable body of literature on how the public perceives research and how this can be measured, less focus has been paid to how researchers themselves deal with the public. Scholars in this line of research have focused on a) the relationship between science and specific publics, for instance, the media (32–34) or politics (32), b) the relationship between science and the broader public (32, 35–37) or c) the communication practices of single disciplines (38, 39). Here, recurring themes are researchers' motivations for engaging with the public (40, 41), teaching and training (42, 43), and institutional conditions (44–46). Research here is characterized by a number of relevant individual case studies, but also by a lack of comparable empirical evidence.

Drawing from this rich body of literature, we find a research gap in researchers’ anticipation of different publics, their impact goals as well as their use of engagement formats across different disciplines and institutional backgrounds. We regard research in this area as fundamental to designing effective policies that take epistemic cultures and different institutional settings into account.

Research Interest

The aim of this article is to provide a clearer empirical picture of the researchers' perspective on societal impact, their impact goals and practices to achieve these. We define three overarching research questions:

- **RQ1 (opinion)**: What are researchers' opinions on societal impact with regards to the importance of engagement in their job and at their institutions, their opinion towards evaluation, and the performance of press departments)?
- **RQ2 (goals)**: Which societal goals do researchers aim to achieve with their research?
- **RQ3 (formats)**: Which formats do researchers use to achieve societal impact?

Opinions, goals and formats are not independent of context factors and individual researcher characteristics. Inspired by Cohn's theme-centered interaction (47, 48) and Luhman's notion of meaning (49, 50), we differentiate three dimensions of explanatory variables that are reflected in our survey instrument and which inform the presentation of the results:

- The *content dimension* is defined by the researcher's disciplinary background and the focus on more basic or applied research questions.

It can be assumed that opinions on societal impact and practices to achieve it differ between disciplines. We furthermore expect that there is a difference between researchers who consider themselves applied researchers and those who consider themselves basic researchers, in that the societal impact plays a greater role for applied researchers (51–55).

- The *organizational dimension* is defined by the type of research organization (i.e., universities, universities of applied sciences, non-university research institutions).

The consideration of organizational factors influencing science communication has, with notable exceptions (44, 45), been little researched so far. It can be assumed that the organizational cultures and support structures have an influence on whether and how researchers achieve societal impact. Here, we are interested in differences between various types of public research institutions in Germany (see Method section below).

- The *individual dimension* is defined here by the socio-demographic factors gender, status, and age.

Gender and age differences in relation to human agency are widely researched in the social sciences, also in relation to scholarly communication (56–61). In relation to the engagement with society, these aspects are still little understood.

Method

Preparatory work and instrument

We designed a standardized questionnaire. The opinion questions (RQ1) comprise Likert scale items on researchers' attitudes towards societal impact as part of their jobs, the evaluation of societal impact, the importance of science communication at their institutions, and the performance of institutional communication departments. We considered agreement as the last two answer categories of a 5-point Likert scale (agree + agree completely).

The multiple-choice questions on impact goals and engagement formats (RQ2) are based on the main categories of an extensive inductive coding of the impact case studies of the Research Excellence Framework (REF), which we carried out as a student exercise in spring 2019. These case studies serve as a basis for evaluating societal impact in the REF and are well-suited for

identifying relevant goals and formats without normative assumptions. The main categories are reflected in the questions on impact goals (i.e., What societal impacts do you want to achieve with your research?; 13 questionnaire items) and formats (i.e., Which transfer formats have you already used to communicate your results?; 6 questionnaire items). Each question allowed further responses in an open text field—from the few additional mentions and the high response rate we conclude that the identified categories are robust.

We conducted a pretest with researchers from different disciplines and topical experts on the usability and comprehensibility of the instrument. This led to minor changes in the design of the survey and the wording of questions. For example, a few items in our instrument relate to the respondents' opinions on 'societal engagement' (RQ1). There exists a large variety of terms for practices on the science-society interface (e.g. public engagement, science communication, knowledge transfer). Although these are important for the scholarly discourse, these are difficult to distinguish or irrelevant for researchers who do not usually deal with this topic. In order to make the survey comprehensible for the respondents, we therefore have used terms that are widely known and have illustrated them with examples and explanations. Here, we report the results as queried in the survey. The questionnaire was implemented online in LimeSurvey. The instrument and the coding sheet of the REF case studies can be found on the project website.[1]

Sample design and distribution

We designed a semi-convenient sample, which means that any researcher could participate in the online survey. However, in order to reach researchers from different organizational settings, disciplines, and career stages in Germany, we used a structured distribution system: To this extent, we contacted the faculty heads of 60 German universities and 60 universities of applied science ("Fachhochschulen") and asked them to distribute the survey to researchers in their

[1] https://www.impactdistillery.com/2020-impact-survey/

faculties. We selected the universities and universities of applied sciences based on the number of students and chose the 20 largest, the 20 smallest and 20 medium-sized. Additionally, we contacted the directors of each institute within the biggest German non-university research organizations, i.e. the Max Planck Society, the Leibniz Association, the Helmholtz Association, and the Fraunhofer Gesellschaft as well as the German Research Association's (DFG) graduate schools. Despite these efforts, our sample is a convenience sample and we assume a certain self-selection bias due to the topic of the survey. Second, the sample consists of researchers in Germany and the results are only transferable to other research and innovation systems to a limited extent.

The distinction between different organizational types of research institutions (i.e. universities, universities of applied sciences, non-university research institutions) is important in the context of this study: Non-university research organizations are characteristic of the German research system. They are typically independent from universities, focused on specific fields of research, and the researchers at these institutions are not obliged to teach. These non-university research organizations include institutes of the Max Planck Society, the Helmholtz Association of German Research Centres, the Leibniz Association, and the Fraunhofer Society. This is relevant for our survey because — presumably — researchers from these institutions are able to devote more resources to transfer activities than researchers at universities that have teaching obligations. Universities of applied sciences are academic institutions that are rather transfer-oriented and usually specialized in certain fields (e.g. arts, technology, or business). Researchers from these kinds of institutions typically have the highest teaching obligations among German researchers. However, due to their applied approach, one would assume that societal impact plays a more central role at these institutions as compared to the traditional universities.

We conducted the online survey from April to June 2020. Participants were invited with an initial email and one reminder, both including a request to distribute the survey among colleagues.

The survey took place during the global Corona pandemic. It cannot be completely ruled out that the researchers' experience of the pandemic influenced the response behaviour.

Sample description

Overall, 841 people started the survey, 534 of whom completed it (63.50%). In this paper we focus on those that stated that their primary work location is Germany, leaving us with 499 valid cases to analyze. Figure 1 provides an overview of the sample.

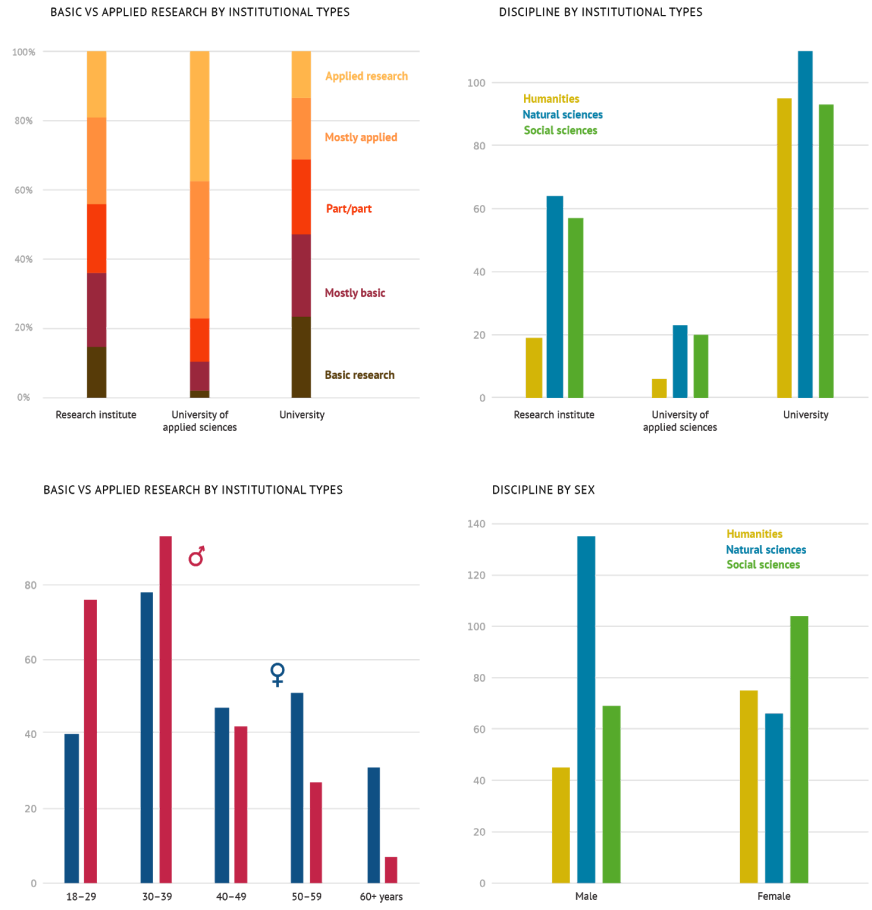

Figure 1. Sample description. (1) Basic vs. applied, grouped by institutional types. (2) Disciplines, grouped by institutional types. (3) Sex, grouped by age. (4) Disciplines, grouped by sex. The number of participants with *other* sex was so small that it is not included in these graphs.

Taking a look at the summary statistics, our distribution system seems to have had the desired effect of achieving responses from all disciplines and institutions. Regarding sociodemographic

characteristics, the genders are equally distributed (50% male, 49% female, and 1% others). For ages 18 to 29 there are almost twice as many females as male researchers in the sample, while there are almost twice as many males than females in the age group 50 to 59 years. For the 60+ group, there are approximately three times more male than female researchers in the sample (we excluded others due to the small sample size of 1%). This, however, corresponds roughly to the general gender distribution in German academia (62, 63).

60% of our participants work at universities, 28% at independent research institutes, 10% at universities of applied sciences, and 2% at other forms of institutions. 34% are working on their PhD, 25% are post-docs, 11% are academics without a PhD, 25% are professors and 5% are others.

We used the classification of the German Research Association (DFG) to query disciplinary backgrounds. During data preparation, we merged the disciplines into three groups: 41% of the respondents are from the natural sciences, 35% from the social sciences and 26% are from the humanities.

Results

In the research section we present the results of the three research questions alongside the three dimensions of independent variables, i.e. content dimension, organizational dimension, and dimension of a researcher's individual characteristics.

RQ1 – Opinion: Science communication is part of the job

Content dimension: Applied researchers are more in favor of societal relevance being given greater consideration in the evaluation than basic researchers (see figure 2). Across all disciplinary groups, researchers largely agree that public engagement is part of scientific activity (from 86% in the Natural Sciences to 93% in the social Sciences). Fewer would consider it part of evaluations: Only 40% of the respondents from the natural sciences agree that societal impact should have more weight in evaluations, compared to 65% of researchers from the social sciences and 58% of researchers from the humanities. Researchers from the humanities are the least convinced that their institutional press departments reach relevant stakeholders in society—only 15%, compared to 30% of the natural scientists and 31% of the social scientists.

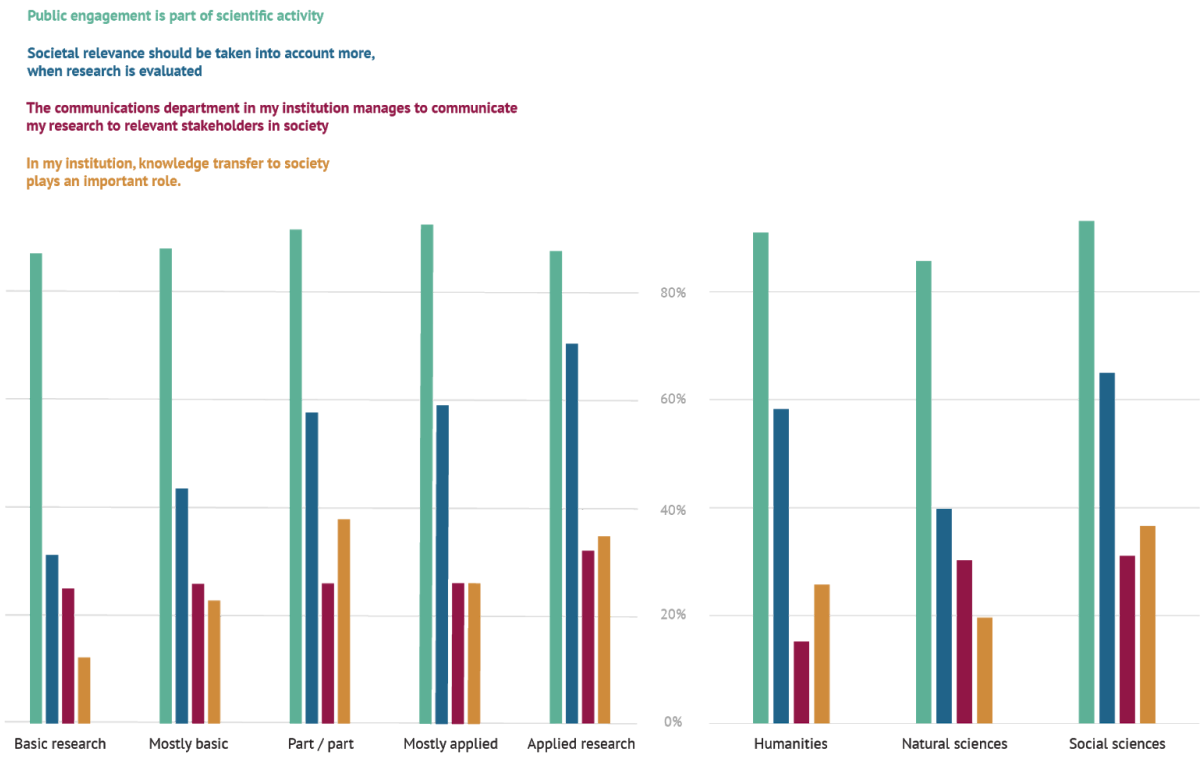

Figure 2: Opinion by type of research and disciplinary group. Question text: "How strongly do the following statements apply to you?"

Organizational dimension: Similarly, across the organizational backgrounds, the agreement to the question of whether public engagement is part of scientific activity is high (ranging from 86% for researchers at universities of applied sciences, to 91% for researchers at non-university research organizations). Researchers at universities of applied sciences agree more often that societal relevance should have more weight in evaluation (62%) than researchers from non-university research organizations (49%) and researchers from universities (53%). Few researchers say that knowledge transfer to society plays an important role at their institution, and even fewer that the institutional press departments manage to reach relevant stakeholders in society. University researchers in particular disagree with the statement that their institutional press departments are able to reach relevant stakeholders in society: 15% compared to 44% at independent research institutions and 28% at universities of applied sciences. Respectively, 19% of researchers at universities agree that knowledge transfer to society plays an important role at their institution, in comparison to 36% at universities of applied sciences and 37% at independent research institutions.

Individual dimension: Both male and female researchers regard public engagement as part of scientific activity (89% and 90%). However, female researchers agree more than male researchers that societal relevance should be part of research evaluation (62% compared to 44%). By tendency, younger researchers are more in favor of evaluating societal relevance. There are noteworthy differences among the status groups: 60% of the doctoral researchers and only 42% of the post-docs and 47% of the professors in our sample agree that societal relevance should have more weight in evaluation. Age doesn't seem to have an effect on the opinion whether public engagement is part of scientific work.

The differences in the assessment of evaluation explain why we did a regression analysis (see table 1) which confirms the descriptive observations: Humanities scholars ($p=0.01$) and behavioral scientists ($p=0.00$) are significantly more inclined to agree that societal relevance

should be part of research evaluation, compared to natural scientists. Furthermore, female researchers (controlled for discipline), applied researchers and younger scholars are significantly more in favor of including societal relevance in research evaluation.

OLS Regression

Dep. Variable:	is_evaluation	**R-squared:**	0.185
Model:	OLS	**Adj. R-squared:**	0.175
Method:	Least Squares	**F-statistic:**	18.39
Date:	Tue, 12 Jan 2021	**Prob (F-statistic):**	2.68e-19
Time:	17:33:38	**Log-Likelihood:**	-760.08
No. Observations:	494	**AIC:**	1534.
Df Residuals:	487	**BIC:**	1564.
Df Model:	6		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.5932	0.234	2.540	0.011	0.134	1.052
Humanities	0.3468	0.136	2.546	0.011	0.079	0.614
Social Sciences	0.4576	0.124	3.694	0.000	0.214	0.701
sex[T.Weiblich]	0.3362	0.111	3.040	0.002	0.119	0.554
age.cat.codes	-0.1035	0.043	-2.393	0.017	-0.189	-0.019
is_applied	0.1760	0.036	4.902	0.000	0.105	0.247
is_academictask	0.3539	0.062	5.724	0.000	0.232	0.475

Table 1: Ordinary least square regression on the evaluation question.

We conclude that across all researchers, the agreement that public engagement is part of scholarly activity is high. There are, however, interesting differences regarding the question to what extent societal relevance should have more weight in evaluations. Researchers from the social sciences and humanities, younger researchers, and female researchers are more likely to agree that science communication should be part of evaluation. It is noteworthy that only a few of the researchers surveyed report that knowledge transfer plays an important role at their institution. Most of the respondents—especially researchers at universities—do not think that their press department manages to reach relevant stakeholders in society.

RQ2 – Goals: Fields define impact goals

Based on the coding of the REF impact case studies, we identified thirteen societal impact goals. The respondents were allowed to select all that they consider relevant for their research. The interviewees had the opportunity to specify further goals in an open text box. Only 36 of the 499 respondents made use of this option; the responses specified the intended impact goals but could be assigned to the already identified goals, which leads us to conclude that the identified categories are robust.

Content dimension: Scholars from the humanities have rather culture- and discourse-oriented goals, social scientists have rather discourse-, social-justice-, and policy-oriented goals, and natural scientists have technology-, health-, and environment-oriented goals. As a disciplinary group, natural scientists chose the fewest items in the multiple-choice question. We find that for all disciplinary groups, making a contribution to education is among the top three impact goals: 87% of the humanities scholars consider this a goal, compared to 70% of the behavioral scientists, and 58% of the natural scientists. For humanities scholars and social scientists, stimulating and supporting public discourse is among the top three impact goals (80% for the humanities scholars and 74% for social scientists). 62% of the humanities scholars furthermore

consider preserving cultural heritage a goal of their activities; 54% of the social scientists consider strengthening the position of disadvantaged groups to be an impact goal. The main goal for natural scientists is to drive technical innovation (59%), followed by making a contribution to education (58%), and contributing to the physical and mental wellbeing of the population (46%). When considering applied vs. basic research, the differences between the communication goals are negligible.

Figure 3: "What social effects do you most likely want to achieve with your research? With my research, I would like to …", grouped by the main disciplinary groups. The options "... contribute to national and/or international security." and "... create an entertainment offer." were chosen by less than 10% of the respondents and are therefore excluded.

Organizational dimension: When looking at the different types of organizations, it is noticeable that universities of applied sciences have more economy-oriented goals, while non-university institutes have more policy-oriented goals and university researchers feel more committed to the preservation of cultural heritage. 41% of the researchers from universities of applied sciences indicate that they aim to contribute to the economic value creation, while only 19% of researchers from non-university institutions and 17% of researchers from universities consider this a societal impact of their work. Similarly, 39% of the researchers from universities of applied science indicate that they want to improve working conditions in organizations, compared to only 25% or researchers from universities and 22% of researchers from non-university research institutions. 54% of the researchers from non-university research institutions aim to contribute to political decision-making, whereas only for 31% of the researchers from universities and 37% of researchers from universities of applied sciences considered this a relevant impact goal. Notably, contributing to education is a major goal throughout all organizational types, including non-university research institutes, which typically have no teaching obligation.

Individual dimension: Young researchers (age group 18–29 years, mostly PhD students) are the age group that stands out. They are less inclined to contribute to public discourses (37% for young researchers in comparison to 65% for 30–39-year-old researchers) or address politics (21% for young researchers in comparison to 48% for 40–49-year-old researchers). Regarding gender, we see that male researchers are more inclined to pursue goals that are also related to their disciplines and vice versa. For example, technical innovation is a goal for 43% of the male researchers and for 20% of the female researchers. Female researchers are more interested in supporting minorities (41%) than male researchers (25%). We don't find that the status of the respondents has any noteworthy effects on the goals.

In conclusion, we find that the impact goals are best explained by the content dimension: Scholars from the humanities have rather culture- and discourse-oriented goals, social scientists

discourse- and policy-oriented goals and natural scientists technology and health-oriented goals. It is noteworthy that for all groups, contributing to education is a major impact goal. We observe noteworthy differences between the organizational backgrounds, where it is particularly researchers from non-university research institutions that aim to inform politics, researchers from universities of applied sciences that aim to contribute to economic growth, and researchers from universities that aim to preserve cultural heritage. The latter can also be explained by the fact that a large number of researchers from the humanities work at universities.

RQ3 – Formats: University researchers are least active

Based on the REF coding, we identified six major categories of formats that researchers use to reach societal actors. These are: educational offers, advisory services, events, press activities, social media communication, and collaborations. The respondents could choose all formats that they have used in the past, which further allows us to compare the intensity of engagement activities. Again, the respondents were able to add additional formats in an open text field, which led to 20 additional answers that could be assigned to the predefined categories.

Content dimension: We find that overall, the most used formats are events (68%), followed by press activities (45%), educational offers (43%), social media communication (38%), consulting (33%), and collaboration (33%). It is noticeable that humanities scholars are most active on social media: 55% have used social media to communicate their results, compared to 33% of natural scientists and 38% of social scientists. Social scientists are most experienced with consulting: 50% have used consulting formats, compared to 28% of the humanities scholars and 24% of the natural scientists. In general, the natural scientists show the lowest activity compared to other disciplinary groups (measured in formats used). However when it comes to collaborations with practice partners, they score relatively high: 36% of the natural scientists and 37% of the social scientists had practice collaborations, compared to only 26% of the

humanities researchers. When differentiating between applied and basic research, it is noticeable that basic researchers have hardly used consulting formats (14% for basic researchers vs. 47% for applied researchers) nor practice collaborations (17% for primarily basic research vs. 39% for primarily applied researchers).

Organizational dimension: The choice of formats differs according to the organizational background (see table 2). Scientists from non-university institutions are more open to direct communication via social media. The greatest differences can be found in collaborations and consulting formats—primarily scientists from universities of applied sciences primarily have used these formats. Only 26% of university researchers have engaged in consulting, compared to 40% of researchers at non-university institutions and only 26% of the researchers at universities. Similarly, only 28% of the researchers from universities have used collaboration formats, compared to 53% of researchers from universities of applied sciences and 35% of the researchers from non-university institutions. Generally university researchers score remarkably low on every science communication format.

	University	University of applied sciences	Research institute
Education offers (e.g. for schools, civil society groups)	43.6%	59.2%	39.3%
Advisory services (e.g. reports for politicians/administration/enterprises/NGOs)	25.8%	57.1%	40.7%
Events (e.g. public lectures, exhibitions, expert panel discussions)	61.4%	71.4%	79.3%
Public relations (e.g. through comments in newspapers, interviews, appearances in TV programs)	38.6%	59.2%	55.0%
Social media communication (e.g. podcasts, Twitter)	31.9%	22.5%	54.3%
Collaborations with non-scientific partners (e.g. citizen science, industry partnership)	27.9%	53.1%	35.0%

Table 2: "Which transfer formats have you already used to communicate your results?" by institutional type.

Individual dimension: In relation to the individual characteristics, it is noteworthy that social media platforms are used more by younger scientists. Less surprisingly, the older a researcher is, the more likely it is that he or she has ever used a format. Older scientists especially have used consulting formats (see table 3). Regarding gender differences, we do not find significant differences except for consulting, which is more likely for male researchers (43%) than female researchers (24%).

In many regards, the preferred engagement formats echo the impact goals of the disciplinary groups. In particular humanities scholars use social media to communicate their research (one of their major impact goals is to contribute to the public discourse). Consulting formats are most used by social scientists and appear adequate to inform policy-making (one of their main impact goals). Collaboration formats (e.g. with industry), which natural scientists use frequently, appear adequate to drive technical innovation (one of their main impact goals). It is furthermore striking that university researchers are by far the least active group for almost every format we queried.

Discussion

The aim of this study was to generate comparable empirical results on researchers' pathways to societal impact across different disciplines, organizational types and researcher characteristics. This study cannot provide a conclusion on whether this impact was achieved or whether more activity leads to more impact. However, it highlights what we believe is an important perspective that has received little attention in discussions about social impact - that of the researchers. We assume that sustainable strategies for societal impact must take this perspective into account, also in order to avoid adverse effects for the science system.

When observing the political discourse on societal impact, it appears that it is increasingly the task of researchers to help solve societal problems. The majority of researchers in our survey feel the same way—they regard engagement with society as part of their job. Fewer, but still many, agree that it should also have more weight in evaluations. Some results stand out and have, in our eyes, policy implications:

Impact goals vary between disciplines: Researchers from the humanities have rather culture- and discourse-oriented goals, social scientists discourse- and policy-oriented goals and natural scientists business- and health-oriented goals. Even though these are large disciplinary groups, it is evident that researchers have specific interfaces to society. This is noteworthy, because much of the policy debate on societal impact of research is concerned with the broader societal impact and not the specific societal impact. For instance, the German Ministry for Science and Education published a policy paper in 2019 that stated explicitly that researchers need to be able to translate their findings for the broader public and engage in public discourse (10). In the light of our results, this might be true to a certain extent, however, it does not do justice to the specific societal impact that researchers ascribe to their work. An overemphasis on the broader impact on society in research governance (e.g., by using attention scores in evaluation exercises), might lead to researchers becoming louder but not necessarily more relevant.

Activity differs by organization type: Most researchers in our survey say that societal engagement plays no important role at their institutions and that press departments do not succeed in reaching relevant stakeholders in society. In both respects, German universities consistently underperform compared to universities of applied sciences and non-university research institutions. Researchers at universities furthermore show the lowest level of activity (measured in formats used). A reason for these shortcomings could be the mere size of universities and insufficient support structures. In Germany, for instance, the increased societal need for research translated into the growth of university press departments, which—in the light

of our results—can hardly cover the complexity of research nor society (64). Here, we argue, that much more focus should be given to decentralized support structures and capacity building on faculty and research group level. Generally, we suggest that impact evaluations should take the conditions for impact more fully into account, when it comes to the input factors, i.e., organizations' investments in engagement training and adequate support infrastructure, rather than counting outputs.

Researchers achieve impact through education: For researchers from all disciplinary groups and organizational types, contributing to education is among the top three impact goals. For researchers from the humanities it is even the most important impact goal. Educational formats (beyond university teaching) are furthermore among the three most used formats to reach societal actors. Researchers' societal impact through education is in our view utterly underrated. We believe that the educational impact of research needs to be given much more focus in universities' impact strategies and in impact evaluations.

If science is to make a contribution to solving societal challenges, it must be clear under what conditions this is to happen. The study at hand could only shed light on a small, but in our opinion important aspect of this function. We suggest that this survey can be a basis for further in-depth research on the organizational conditions for societal impact as well as for research on different quality expectations on specific science-society interfaces. After all, one question that cannot be answered by a survey is what kind of impact is appropriate, i.e. scientifically justifiable and relevant to society. Furthermore, in particular for supra-national policymaking, comparative surveys of impact practices in different countries would be desirable. Such research is in our view desirable for sustainable and effective impact agendas and necessary to adequately reflect the complexities of the different publics as well as the different sciences.

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