Knowledge transfer

Research practices in the Berlin Research Area

Focus report of the Berlin Science Survey
Pilot Study 2021/22

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Summary

Knowledge transfer encompasses not only scientific communication, but all forms of knowledge exchange between science and various social groups. Such an exchange can occur in different phases of the research process. Thus, knowledge transfer does not have to be understood as a one-way process from science to society, but can flow in both directions, such that both sides stimulate and enrich each other.

To quantify the potential for knowledge transfer, the Berlin Science Survey looked at the perspectives of researchers and asked them for which areas of society they consider their own research to be relevant. The results show that 88% of respondents consider their research to be "fairly" or "very relevant" for at least one area of society (politics, citizens, business, practitioners, art/culture, media, economy). The other 12% consider their research to be "hardly relevant" or "not at all relevant" for any of the seven areas surveyed. These are predominantly respondents who conduct basic research.

However, different disciplines have very different profiles and therefore different transfer potentials. For example, the transfer profile of the humanities and social sciences is geared more towards civil society and politics, that of the life sciences more towards practitioners (e.g. in medical clinics) and that of engineering more towards companies from industry.

The transfer potential is to a large extent already realized. Of all respondents, 73% are in contact with at least one social group; 54% are even in contact with two or more groups. Only 27% are not in contact with any of these groups at all.

An actual exchange takes place most frequently when practitioners (e.g. medical professionals, technicians and teachers) constitute the relevant reference group: of the respondents who consider their own research to be relevant to the group of practitioners, 78% state that knowledge transfer also takes place with this group. For the arts and culture relevance group, this proportion is 64%, for business it is 66% and for civil society 68%.

The intensity of exchange relationships can be classified according to the points in the research process at which the exchange occurs. Exchange *during* the research process - and not exclusively afterwards - is an indicator of more intensive exchange. Of the scientists practicing knowledge transfer, 91% state that they are already in contact with relevant groups before or during the research process. The remaining 9% only engage in non-scientific exchange after completing their research.

The exchange often already takes place during the development of the research question. This is particularly common in exchanges with partners from the business world (61%) and with practitioners (51%). However, the exchange of knowledge with politics, civil society institutions or art & culture also takes place at this early stage in around a third of cases.

Overall, many scientists in the Berlin research area are in contact with social actors outside of academia. There can be no talk of research in an ivory tower here.

Berlin research area & need for support

The majority rate the transfer of knowledge in the Berlin Research Area positively. In terms of knowledge transfer, 45% rate the Berlin Research Area as "fairly well" and 9% as "very well" positioned. On the other hand, a not insignificant minority of 27.3% of respondents consider the Berlin Research Area to be "rather poorly" or even "very poorly" positioned in this respect.

Younger researchers are significantly more likely than more established researchers to claim a need for support in dealing with knowledge transfer. Broken down by status group, 37% of professors, 45% of postdocs and 50% of predocs state a need for support. As expected, the need for support decreases with increasing experience.

Overall, the stated need for support is surprisingly high given the extensive transfer practice that already exists. This indicates that, on the one hand, scientists attach great importance to the topic of knowledge transfer, but at the same time are unable or unwilling to tackle it alone. In fact, the need for support is somewhat more pronounced among those who attach greater importance to knowledge transfer to society. Here it is important that the institutions also take responsibility for the topic so that the entire burden of implementing knowledge transfer does not rest on the shoulders of the individuals.

Attitudes towards the relationship between science and society

The overwhelming majority of respondents (83%) believe that scientists should actively participate in public debates. However, 63% of respondents believe that they should limit themselves to making statements about their own research. Just under 28%, on the other hand, believe that scientists should also contribute to public debates beyond this. This shows that scientists consider it necessary to contribute scientific expertise to social discourse, but less in the sense of public intellectuals who comment on many things, and always with clear reference to the knowledge they have produced themselves.

The importance of scientific autonomy is controversial in the scientific community: While 45% are (rather) in favor of autonomy vis-à-vis society, only slightly fewer respondents (39%) are inclined to say that science should serve society. The remaining respondents take a neutral position here.

These "positionings" depend to a large extent on the respective research subject. In particular, scientists who work more theoretically themselves, but also those who are dependent on technical infrastructures, are more in favor of the autonomy of science than scientists from other research contexts. Humanities scholars are in favor of greater autonomy, while engineering scholars are less reluctant to put science at the service of society. In addition, professors are more in favor of maintaining a high degree of autonomy compared to postdocs and predocs.

The following implications for higher education policy can be derived from these results:

Knowledge transfer is already very much a part of everyday research. Based on the status quo, an increase in knowledge transfer activities by individual researchers is not necessarily to be expected, nor is it sensible or expedient everywhere. The knowledge transfer potential and the respective target group for the transfer strongly depend on the respective subject and the specific research context. Especially for scientists in basic research, the topic of knowledge transfer tends to be of secondary importance.

Overall, there is a considerable need among scientists for support in order to fulfill the desire for knowledge transfer. Support services offered by the institutions could help to make better use of the potential for knowledge transfer.

Contents

1. Introduction

Knowledge transfer is one of the most strongly promoted science policy objectives. In addition to the traditional missions of "research" and "teaching", universities have a "third mission" to fulfill: to have an impact on society (Compagnucci and Spigarelli 2020). In connection with the “third mission”, several terms circulate alongside knowledge transfer, such as technology transfer, innovation and societal impact with the last one referring to the social impact of science.

While in the early debates on knowledge transfer this was understood more as a unidirectional process of transferring finished knowledge, i.e. research results, to various actors in society, a concept of knowledge transfer is establishing itself in current debates that sees science in a stronger reciprocal exchange with society (Nowotny et al. 2001).

More recently, the concept of knowledge exchange has come to the fore. This emphasizes that the transfer does not only have to take place unilaterally from science to society, but can and should take place in both directions, quasi as interaction (Pohl et al. 2021; Olmos-Peñuela et al. 2014). The Berlin University Alliance also defines "Knowledge Exchange as a process of mutual exchange of knowledge between actors from the sciences and various areas of society such as politics, culture and business" (Berlin University Alliance 2023). The various terms all reflect the desire for the products and findings of scientific work to be socially relevant and to demonstrate their added value for society as far as possible. There is a danger here that science will only be geared towards current utility narratives and that scientific findings and scientific progress will be reduced to solving current social problems.

For scientists, knowledge transfer can be an ambivalent goal. If this goal is addressed directly to them as a requirement, they must integrate it into their work alongside many other tasks. Depending on the research subject, this is easier for some than others (Janßen and Schimank 2019). While a high level of exchange with partners in various areas of society is plausible and to be expected in applied research areas, the situation is quite different in basic research. Due to the very different hurdles to integrating knowledge transfer into research practice, there is a risk, as with other science policy imperatives, that individual scientists will not be able to adequately implement the requirement and thus pressure will be placed on them that is neither appropriate nor targeted. Therefore, knowledge transfer could also be seen as a primarily organizational goal and not as the task of individual scientists.

The Berlin University Alliance (BUA) has the vision of developing Berlin into an integrated research area and strengthening cooperation both between the institutions and beyond (Berlin University Alliance 2023). The aim is also to promote multidirectional research and knowledge transfer (ibid.). In order to monitor this objective, the Berlin Science Survey (BSS) was launched to shed light on the changes in research culture and research practices in the Berlin research area from the perspective of science research. In this report, the exchange of knowledge between scientists in the Berlin research area and society is analyzed in depth. Based on the analysis of the current situation, existing potentials are identified in order to intensify the exchange of knowledge.

The basic assessment of the *Berlin Science Survey* has already shown that the relevance of the individual research areas for various non-scientific areas of society varies, but is rated quite highly overall. Across all subject groups, only a few respondents state that their research is not relevant to any non-scientific area (Lüdtke and Ambrasat 2022a).

This focus report examines the topic of knowledge transfer in depth on three levels. At the level of practices, we look at the extent of the exchange between scientists and non-university actors. How do scientists assess the relevance of their own research for society? Where is there (still) potential to intensify knowledge transfer or exchange? In terms of attitudes, the question is how scientists assess the relationship between science and society. In their opinion, how autonomous should science be in relation to societal demands? To what extent should scientists be involved in political debates? Last but not least, we look at how the respondents see the Berlin research area in terms of knowledge transfer opportunities and whether there is a need for support.

This report answers these questions using data from the pilot study *of the Berlin Science Survey* (Lüdtke and Ambrasat 2022b). 1,098 questionnaires from scientists from the Berlin research area who were surveyed in the winter semester 2021/22 were evaluated. For this survey, two comprehensive instruments were developed to survey transfer practice and the attitudes of academics towards science and society. To record transfer practice, it was determined whether and with which social groups the scientists are in contact. In order to be able to contextualize the exchange appropriately against the background of very different research objects, the scientists were asked in advance for which social groups their own research is actually relevant. A newly developed instrument for surveying knowledge transfer enables a very detailed description of the quality of exchange processes. It is used to determine in which phases of the research process an exchange with non-scientific actors takes place. The survey instrument makes it possible to distinguish between knowledge transfer downstream of the research process, which also includes (pure) scientific communication ex post, and more intensive knowledge transfer, in which the exchange takes place during or even before the research process.

In order to capture the attitudes of scientists towards the interrelationship between science and society, we focused on the following three central areas: the autonomy of science in relation to the social benefits of science, the participation of female scientists in political debates and the scientific-philosophical question of the properties of scientific knowledge.

The report examines and discusses all sub-topics relevant to the topic of knowledge transfer with regard to possible differences between the status groups, between the subject groups and finally also between the gender groups. These three important structural variables are intended to consider the diversity of the scientific community.

The hierarchical classification of status positions into professors, postdocs and predocs does not merely reflect the employment relationship and career position. The position is also associated with a specific portfolio of tasks and roles in research and teaching. It is also an indicator of a researcher's academic experience and resources such as time, money and power.

A second central structural variable is the classification by subject, whereby the analyses here are differentiated according to the subject groups humanities, social sciences, life sciences, natural sciences and engineering. The subject affiliation shapes the researchers through routine work processes, institutional conditions and, last but not least, through a subject-specific understanding of science and science. However, even within a subject group, there are sometimes very large differences in the specific working and research conditions. Differences between subject groups therefore only provide (initial) indications of the diversity of research contexts. We therefore attempt to capture additional differences in the research contexts by including some epistemic characteristics of research (cf. Gläser 2018).

The distinction between male and female researchers is also relevant in the context of knowledge exchange, as it is known from network research that there are gender-specific differences in the establishment of networks (Lutter 2015). Such differences can play a role in the initiation of exchange relationships, for example.

The report first examines the general significance of the topic of knowledge transfer in the Berlin scientific community - especially in relation to other topics funded by science policy (Chapter 2). Next, the scope and potential of knowledge transfer in the Berlin research area are examined (Chapter 3). Attitudes towards the relationship between science and society are then examined (Chapter 4) and placed in relation to the research contexts and transfer practices (Chapter 5). Finally, the framework conditions of the Berlin research area are assessed with regard to knowledge transfer potential (Chapter 6).

2. Importance of knowledge transfer alongside other goals in science

Knowledge transfer is becoming increasingly important in science. The Berlin University Alliance would also like to promote the exchange of knowledge with social actors in the Berlin research area. The *third mission* increases the requirement to examine the scientific knowledge produced for its social utility or even to bring about a social impact. Although societal usefulness does not have the same importance for all research areas per se, science policy requirements and discourses can certainly exert pressure on all scientists and result in such scientists prioritizing these new goals higher than would be useful for the actual research.

This relationship between personal scientific objectives, pressure of expectations and prioritization in scientific work was investigated using an instrument developed specifically for this purpose in the project. Respondents to the *Berlin Science Survey* were asked to assess the importance of "societal impact of research results", the perceived pressure of expectations in this regard and prioritization in their own research practice - in each case in relation to other goals in science.

Figure 1 shows the assessments of societal impact in relation to the other scientific objectives surveyed. The scientists do not see the social utility of scientific results as an overriding goal. The importance of this goal ranks slightly behind interdisciplinary cooperation and open science. At the same time, however, the pressure of expectations is somewhat higher here than for open science and interdisciplinary collaborations. Finally, the prioritization of societal impact in one's own scientific work is also not particularly high compared to the other tasks and goals. Here, knowledge exchange ranks roughly on a par with other science policy imperatives such as open science and interdisciplinarity.

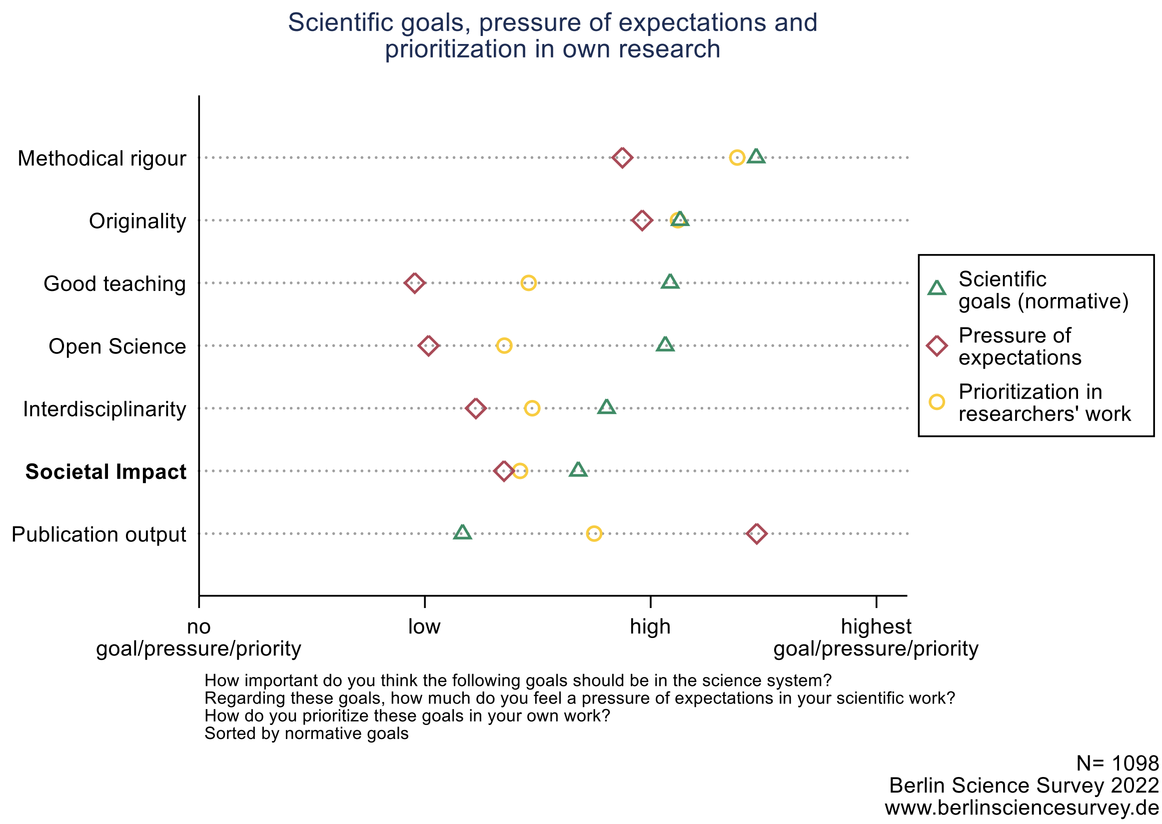

Figure 1 Goals, pressure of expectations and prioritization in one's own work

It can be assumed that the assessments of societal impact depend heavily on research contexts and the type of knowledge produced in each case. In fact, there are some notable, albeit not overwhelming, differences (see Figure 2). In the engineering sciences and even more so in the social sciences, a somewhat higher appreciation of societal impact can be observed - especially in comparison to the humanities. These are the subject areas in which research is also more application-oriented. In contrast, the pressure of expectations hardly varies between the subject groups. In terms of prioritization, the humanities and social sciences are again far apart, with the social sciences prioritizing the social utility of research results the most and the humanities, together with the natural sciences, the least.

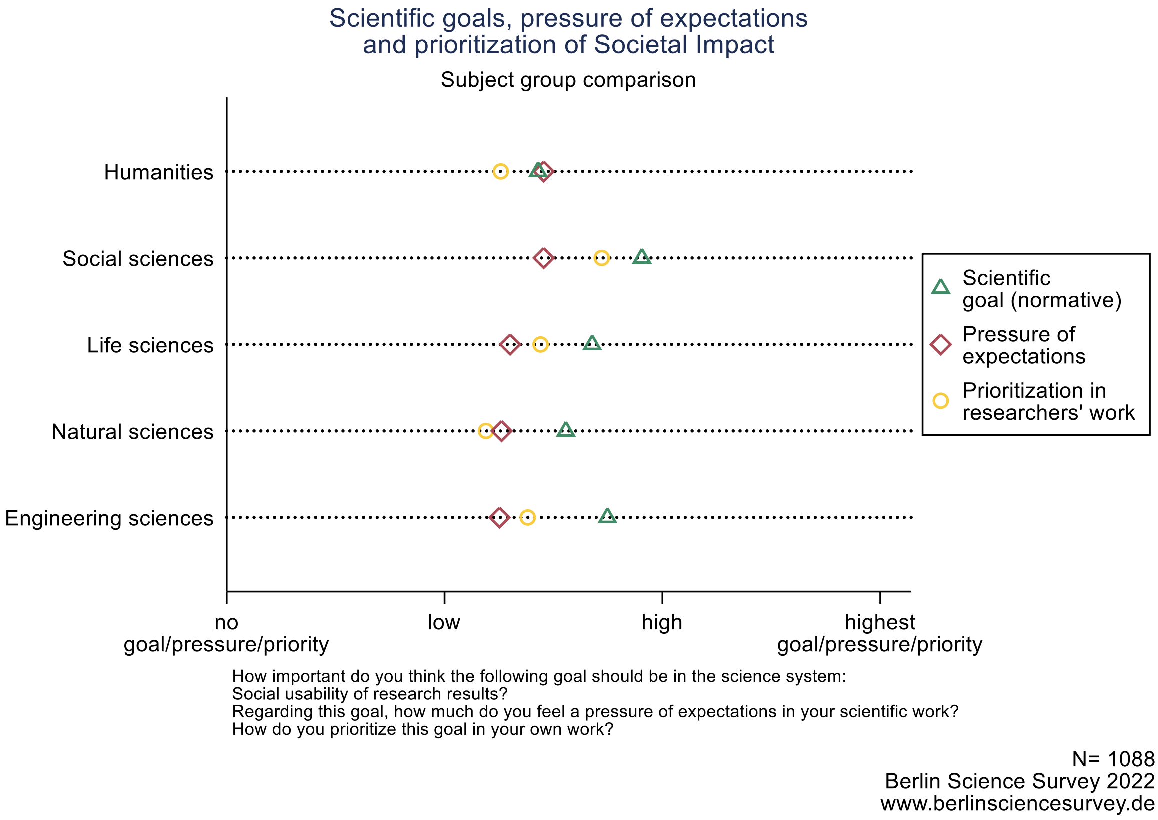

Figure 2 Goals, pressure of expectations and own prioritization of societal impact, by subject group

The assessments for societal impact show that more than half of the respondents classify "social usability of research results" as a "high goal" (40.8%) or even one of the "highest goals" (15.8%) within science (see Figure 3). At the same time, over 41% of respondents feel a "high" (30.7%) or even "very high" (10.4%) level of pressure to achieve added value for society through their own research. Finally, in their own scientific practice, 53.1% of respondents gave this goal "no priority" (16.1%) or "low priority" (37%) and 46.8% gave it "high priority" (35.3%) or even "top priority" (11.5%). The prioritization of various goals in one's own work is driven both by one's own goals and values as well as by the pressure of expectations. At the same time, it can be assumed that the pressure of expectations, as well as goal setting and prioritization, depend on specific role expectations. We therefore also look at the response distributions separately by status group.

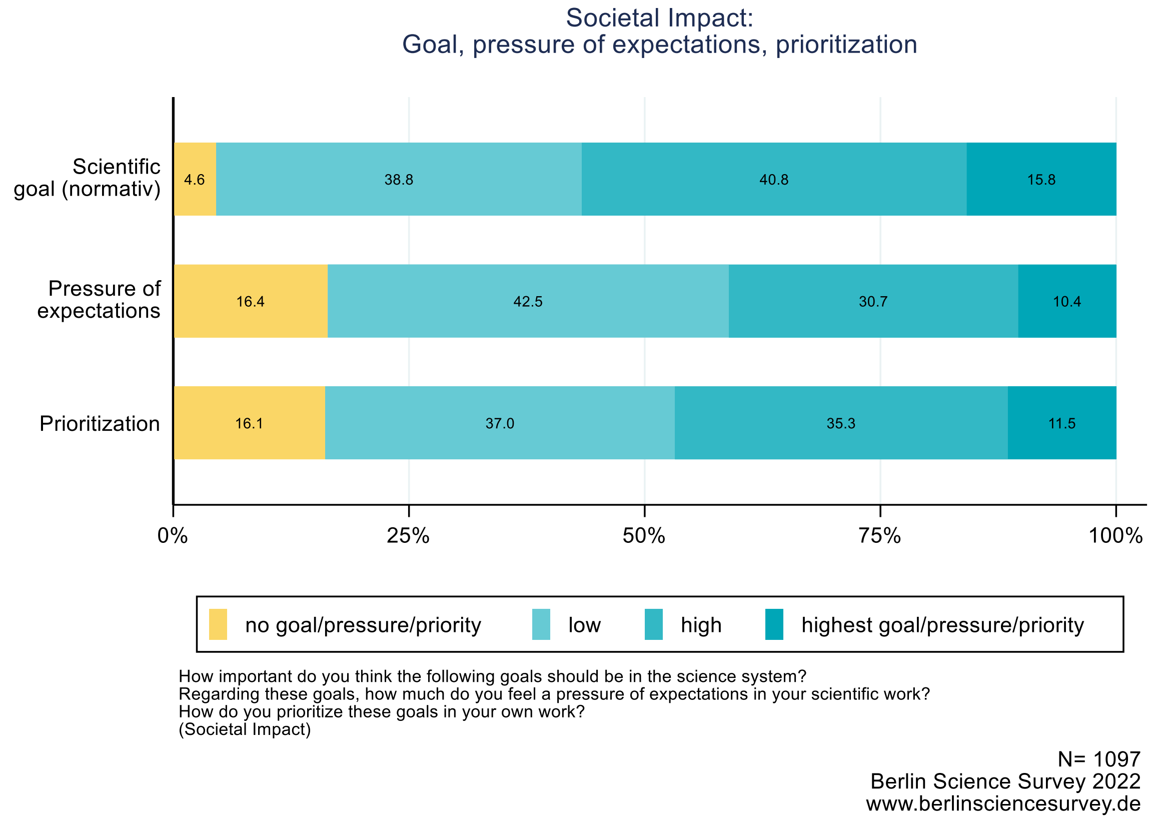

Figure 3 Societal impact: goal, expectation pressure, prioritization

Figures 4 to 6 show the three assessments - importance of the goal, pressure of expectations and prioritization in one's own work - broken down by status group. It is striking that pre-docs assign greater importance to societal impact than higher status groups. Among predocs, 61.1% consider the societal impact of research to be a "high" or "highest" goal. Among professors, only 46.3% consider societal impact to be a "high" or even the "highest" goal in science (see Figure 4). This confirms a trend that we also see with other goals: younger or less established scientists are more inclined to identify with science policy goals than more established scientists, especially professors. The opposite is true for the pressure of expectations: While 37.3% of pre-docs state that they feel a high or even very high pressure of expectation to align their research with societal utility, as many as 53.2% of professors say the same (see Figure 5). When it comes to prioritizing societal impact in their own research, it can be seen that this is determined less by the pressure of expectations and more by their own goal formulation: Predocs (50.2%) are slightly more likely to give societal impact a "high" or even a "top priority" (see Figure 6), although they have the lowest pressure of expectations with regard to societal impact.

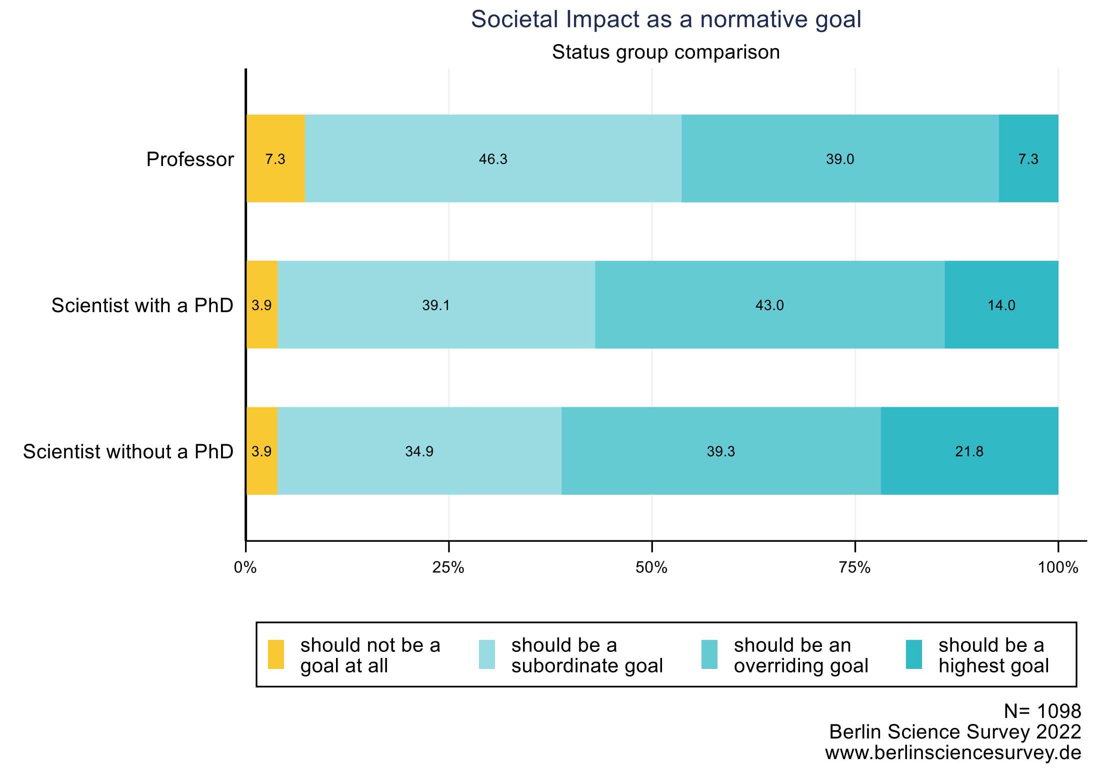

Figure 4 Societal impact: normative goal, by status group

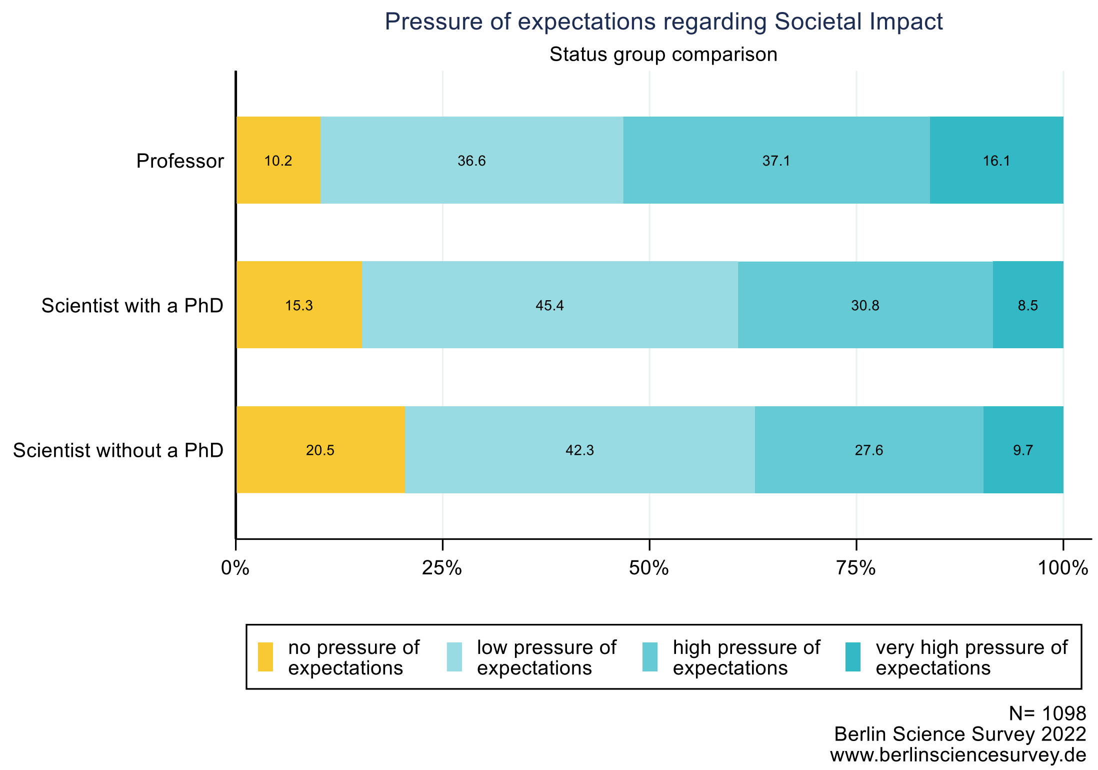

Figure 5 Societal impact: Expectation pressure, by status group

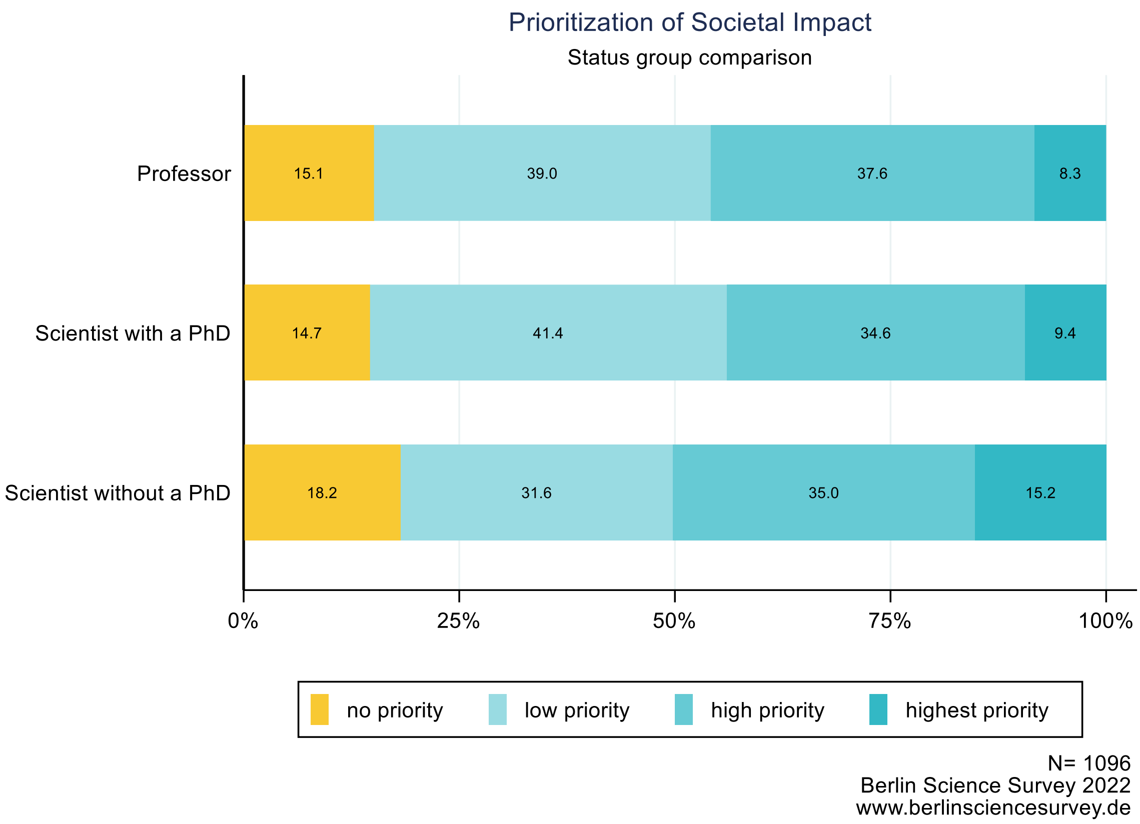

Figure 6 Societal impact: prioritization, by status group

Figures 7 to 9 show the differences in normative objectives, pressure of expectations and personal prioritization of Societal Impact, differentiated by gender. Accordingly, the proportion of those who regard Societal Impact as a "high" or "highest goal" is significantly higher among women (65.1%) than among men (49.2%) (see Figure 7). At the same time, women tend to feel more pressure to meet expectations with regard to the topic and also prioritize it higher in their own research than men (see Figures 8 and 9). However, caution is initially required when interpreting the data, as gender is confounded with the subject structure to a not insignificant extent, and it is therefore unclear whether the effect is really a gender effect or can ultimately be attributed to the subject structure. For this purpose, multivariate models are calculated in the last section of this chapter in order to separate the effects (Figures 10 and 11).

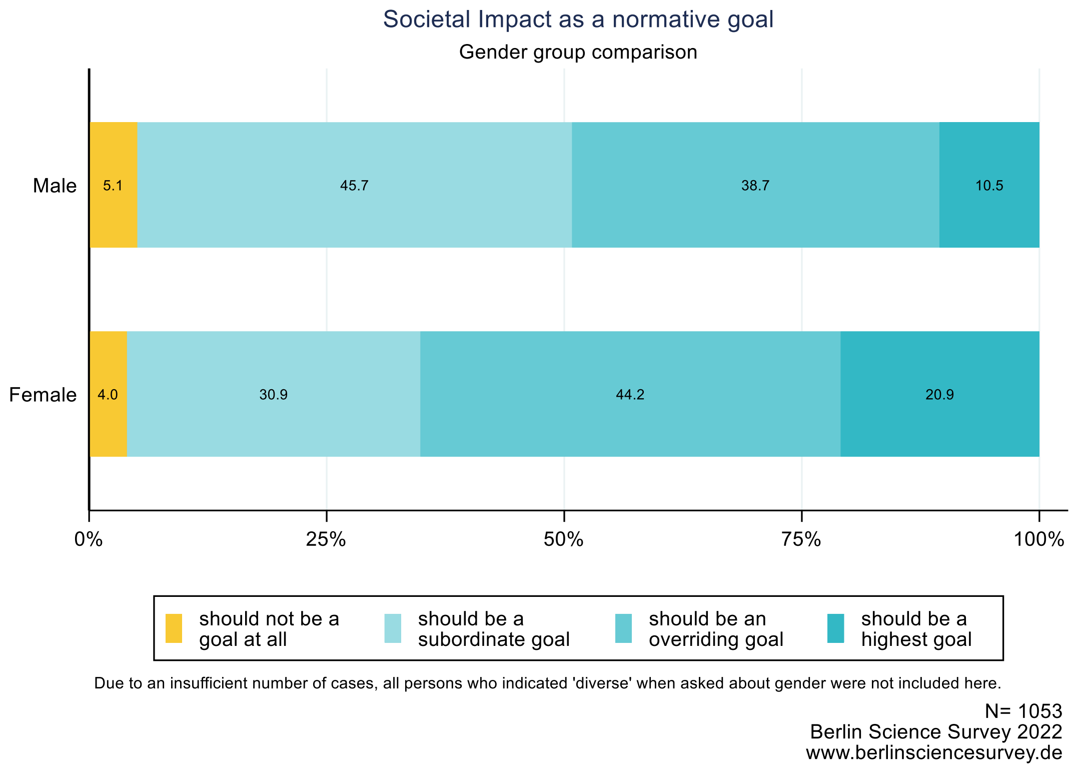

Figure 7 Societal impact: normative goal, by gender group

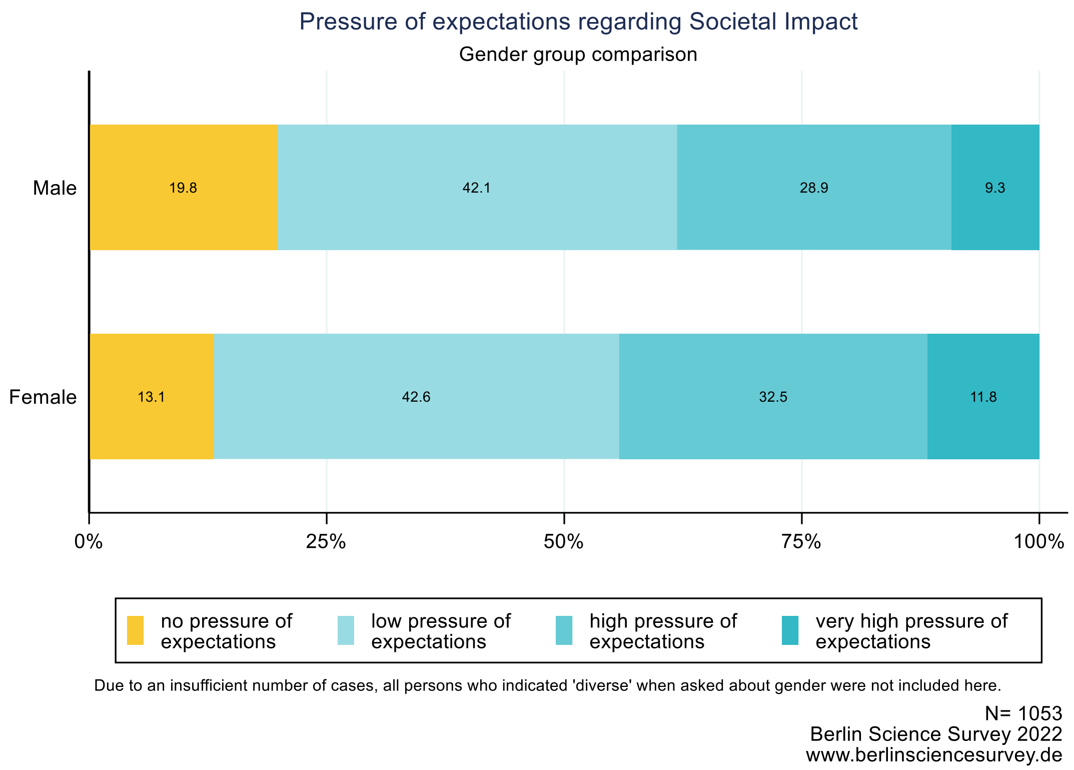

Figure 8 Societal impact: Expectation pressure, by gender group

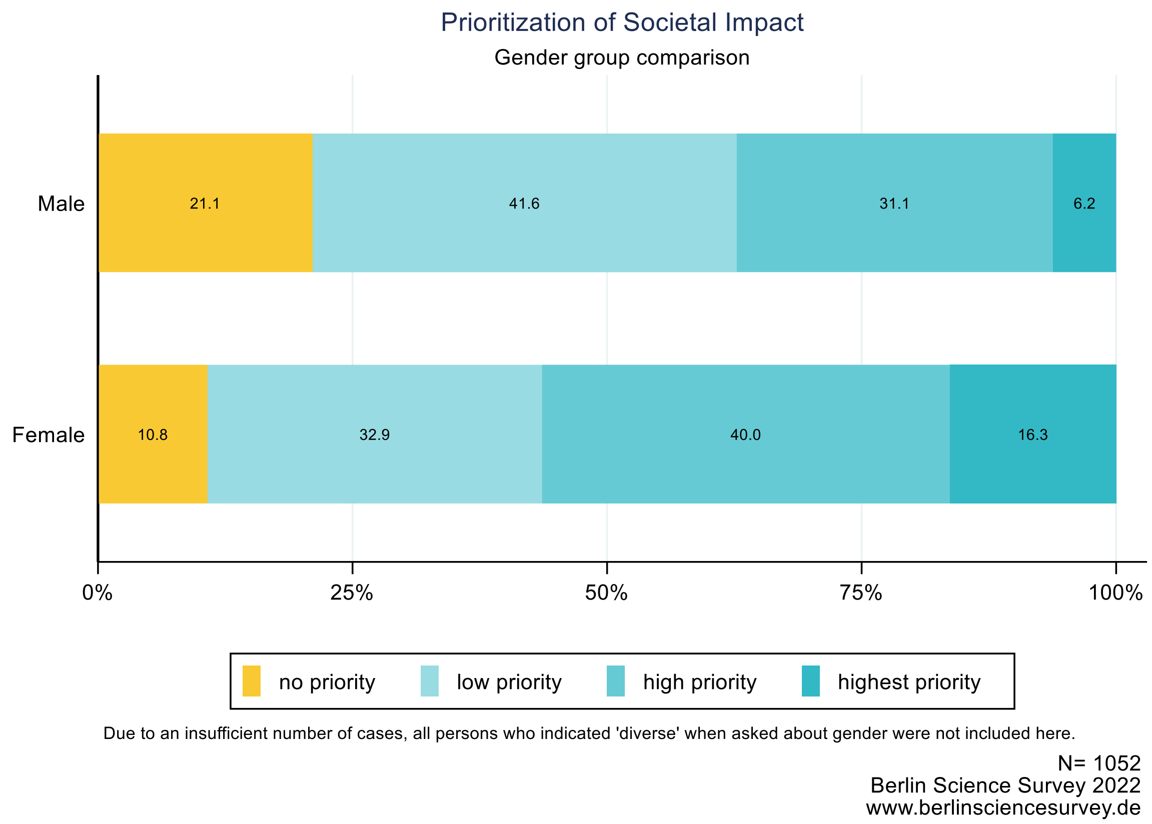

Figure 9 Societal impact: prioritization, by gender group

The bivariate results suggest that the perception of expectation pressure is primarily influenced by membership of a particular status group, while normative objectives in science are also influenced by membership of subject groups. Since the five subject groups contrasted here only roughly reflect the underlying research contexts, it is worth looking at further characteristics to differentiate between research contexts.

We have selected some characteristics that are considered relevant for the differentiation of research contexts based on qualitative science research (Gläser 2018, Laudel and Gläser 2014, Gläser et al. 2010). The characteristics included in the Berlin Science Survey are: theoretical/conceptual work, empirical work, work in working groups or teams, experimental/hypothesis-testing work, work follows a long-term research agenda, work is basic research, work is characterized by competition with other research groups working on the same topic, work is dependent on technical infrastructures.

We included these characteristics as independent variables in a multivariate model to describe different research contexts. Figures 10 and 11 show the results of two multivariate analyses that estimate the influence of various factors on perceived expectation pressure (Figure 10) and on the normative objective with regard to societal impact (Figure 11).

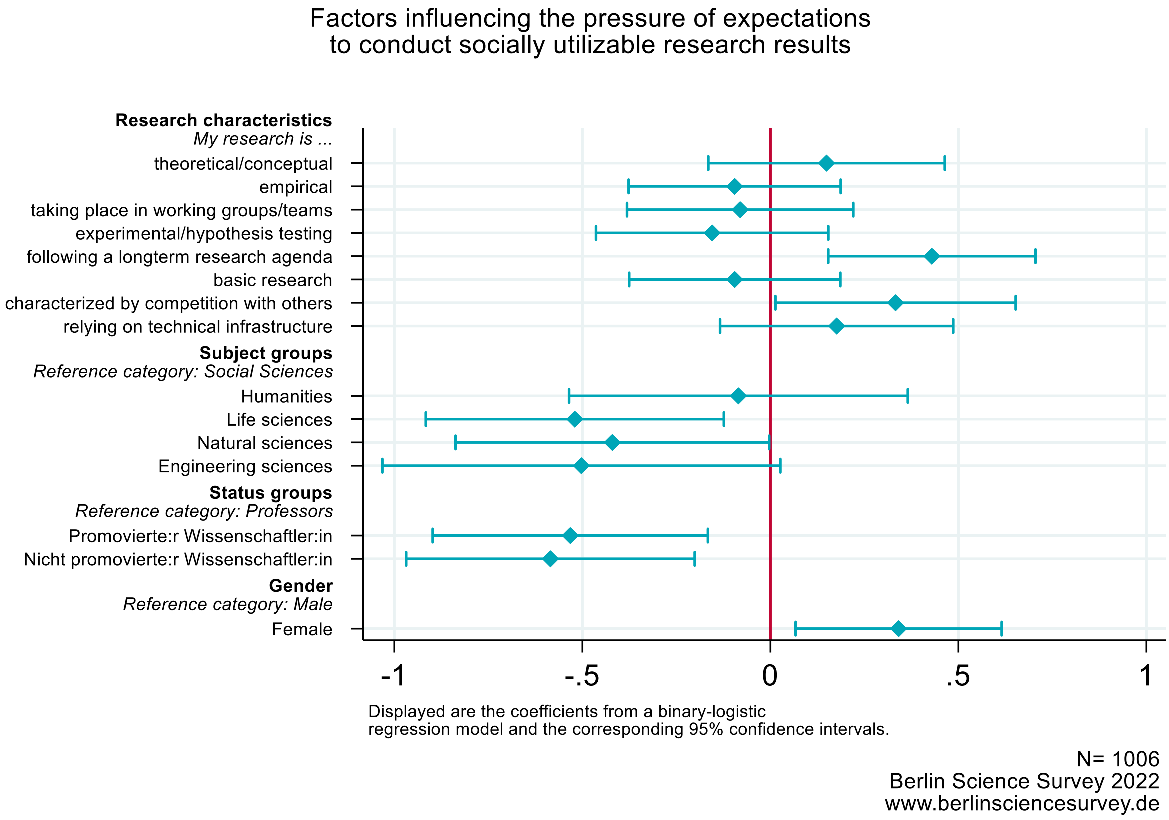

Figure 10 Factors influencing the perception of pressure to meet expectations with regard to societal impact

The analysis of the factors influencing the pressure of expectations confirms the previously identified bivariate findings (see Figure 10). With regard to the subjects, it can be seen that scientists in the life sciences, natural sciences and engineering feel less pressure of expectations compared to those in the social sciences. With regard to the characteristics examined for the identification of research contexts, it can only be seen that if one's own research is "characterized by competition with other research groups working on the same topic" or “follows a longterm research agenda”, greater pressure of expectation is felt than if this is not the case. This could be an indication that competition is particularly high where application-oriented, socially useful research is concerned. Overall, the pressure of expectation is determined more via the subjects than via the specific research conditions. At the same time, membership of the status group is far more relevant. For example, postdocs and predocs feel significantly less pressure of expectations when it comes to societal impact compared to professors. In addition, women feel a stronger pressure of expectations than their male colleagues.

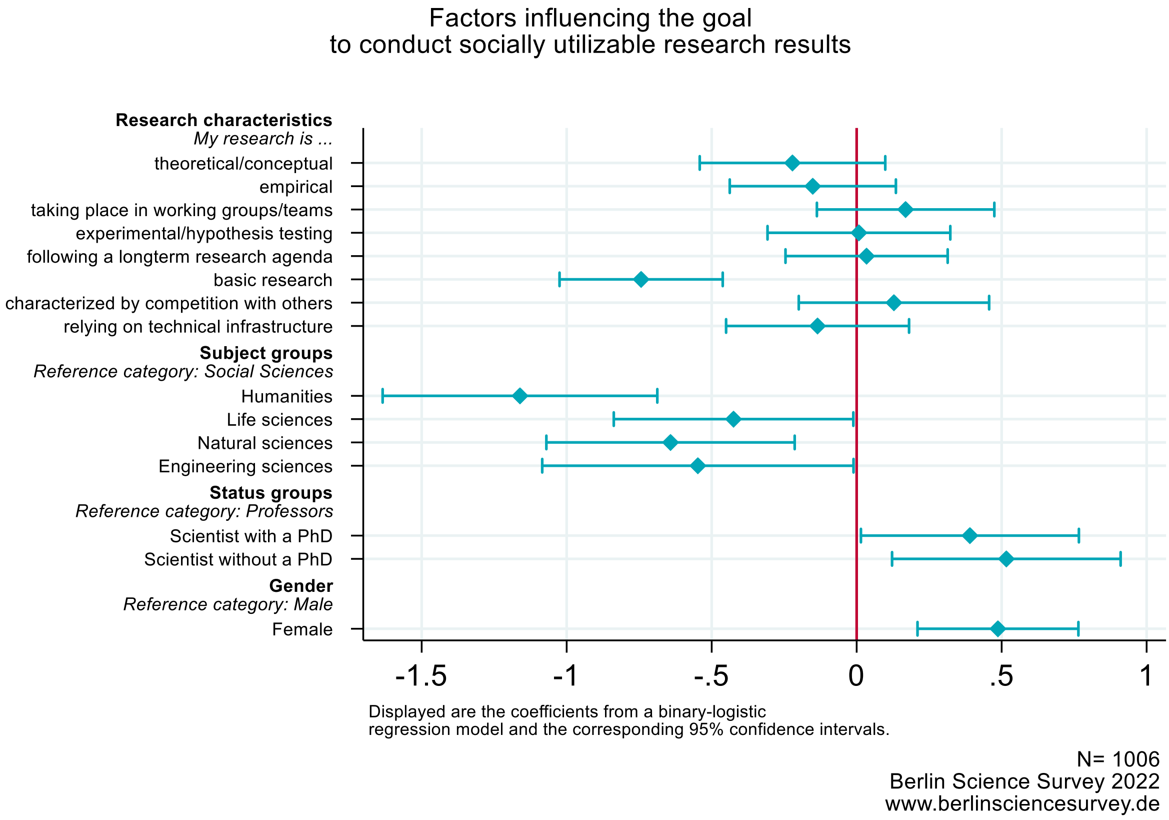

Figure 11 Factors influencing the normative goal of Societal Impact

Figure 11 confirms the bivariate correlations found with regard to gender, status groups and subject groups. It can be seen that societal impact is significantly more important for women. The bivariate findings from the status group comparison are also reflected in the multivariate model. For example, postdocs and predocs rate societal impact significantly more often as a "high" or "highest goal" compared to professors. Furthermore, even after controlling for the other factors, it is confirmed that the importance of societal impact is rated lowest in the humanities and highest in the social sciences. In addition to these subject effects, there is an additional effect related to the characteristic of basic research. Scientists who conduct basic research consider the goal of social utility of research results to be less important than other researchers whose own research subject has a greater application focus per se.

3. Knowledge transfer in the research process

In order to take stock of current knowledge transfer in the Berlin research area, the term knowledge transfer must first be defined. "The Berlin University Alliance defines knowledge exchange as a process of mutual exchange of knowledge between actors from the sciences and various areas of society such as politics, culture and business" (Berlin University Alliance 2023). This is a very strong or narrow concept of knowledge transfer, which we approached step by step in our survey.

In order to determine the knowledge transfer potential in the various research fields, we first asked the scientists which groups outside of academia their research results are relevant for. These assessments provide information about the areas of society into which knowledge transfer activities could potentially be developed. In a second step, we asked whether the researchers are already in contact with the relevant groups. This information indicates the extent to which the potential to transfer knowledge to non-university groups has already been exhausted. Where research is relevant to social groups but there is no exchange with them (yet), there is potential to expand knowledge transfer activities or to support them on the organizational side. Interestingly, such additional potential seems to exist above all in the exchange with citizens and politics (see Figure 14). Conversely, it makes little sense to develop transfer activities indiscriminately without reference to the target group.

3.1 Relevance of own research (knowledge transfer potential)

Most scientists see their research as fundamentally relevant for non-scientific areas (88%). Only a few respondents state that their research is "not at all" relevant to the areas surveyed (2.6%, not shown). For 17.9% of the scientists surveyed, their own research is "fairly" or "very" relevant for precisely one area outside of science. For these scientists, there is therefore a very clear target group. For the remaining 70%, at least two of the areas surveyed are possible addressees for the knowledge transfer of their own research. Almost 20% even state that their research is "fairly" or "very relevant" for at least five areas outside of science.

The relevance assessments are shown in detail in Figure 12. 53.5% of respondents state that their own research is relevant for "practitioners" (e.g. medical professionals, technicians, teachers). 48.4% state that their own research is relevant for "politics" and 48% state "citizens" as the target group of their own research. Politics and citizens are the two areas between which the overlap of mentions is greatest. This means that if the research is relevant to politics, it was often stated that it is also relevant to citizens. In addition, 40.9% stated that their research is relevant for the economy (start-ups, companies, industry). In the case of civil society organizations (such as foundations, associations, federations, NGOs), 39.4% claimed relevance and 32.2% in the case of the media. The values are all quite close to each other, with only the relevance assessment for the arts and culture sector falling slightly behind at 18.7%. This could have to do with the fact that the researchers are not aware of the full spectrum of what art and culture can refer to and therefore do not see an immediate need for knowledge here that needs to be filled (cf. Reinicke et al. 2020). Accordingly, unlike in other non-academic fields, knowledge would be transferred here less according to the push principle and more according to a pull principle (Thiel 2002), in which artists and cultural practitioners themselves access the knowledge that they consider suitable to utilize or refer to. This assumption is also supported by the fact that 54% of respondents do not see any relevance of their own research for the field of art & culture.

The relevance assessments and the associated differentiated target group reference form the frame of reference for the further investigation of transfer and exchange activities. These assessments should also form the basis for any measures to increase knowledge transfer activities in the Berlin research area. It must be acknowledged that assessments of relevance can also change, e.g. as a result of experience with the relevant groups.

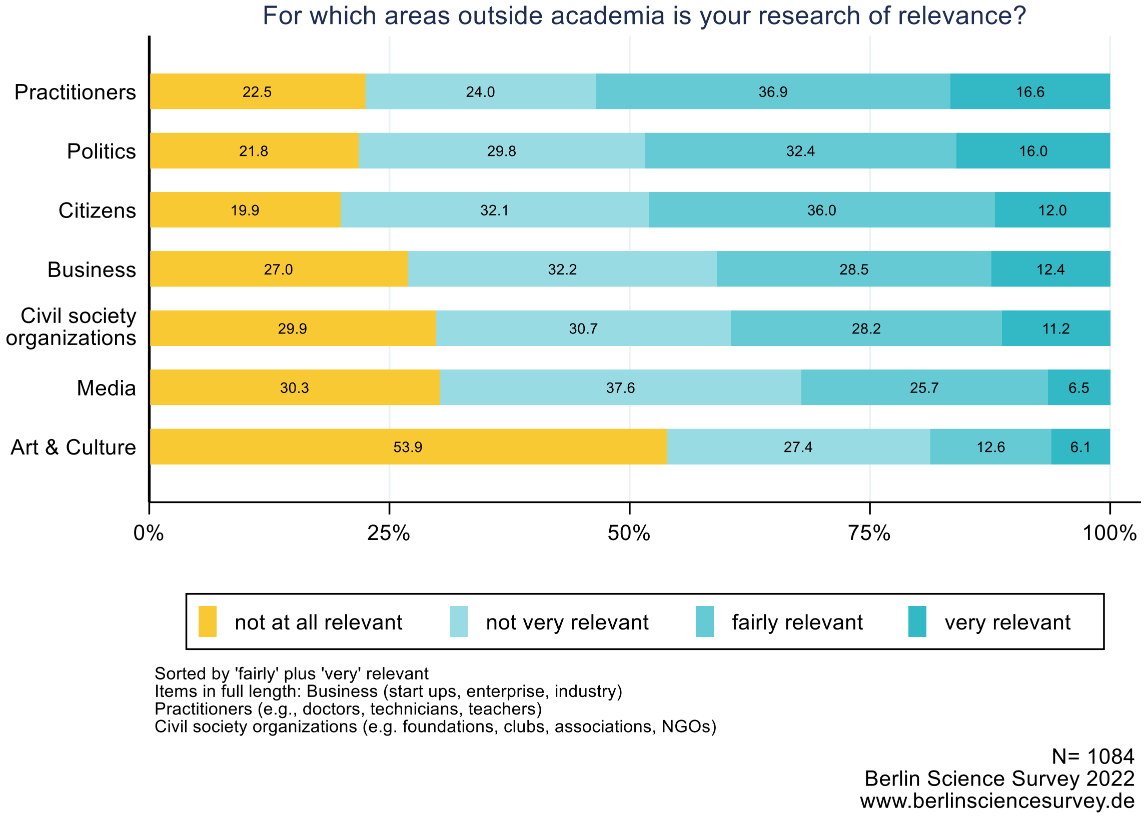

Figure 12 Relevance of research for non-scientific areas

These average values for the knowledge transfer profile conceal clear subject profiles (see Figure 13). These in turn indicate that knowledge with very different social relevance is produced in different research fields. This results in subject-specific transfer profiles or, initially, relevance profiles.

Humanities scholars emphasize the importance of their research for art and culture (just under 73.5%) and for the media (57.1%). In contrast, only a few humanities scholars see the relevance of their research for the economy (11.6%). The scientific results of social scientists are primarily considered important for politics (a good 82%) and civil society actors (69.7%).

In the life sciences (including medicine), the relevance for the group of practitioners predominates (just under 71%). Depending on the subject group, the term "practitioners" can refer to different groups of people, including medical professionals, technicians and teachers.

Scientists, like engineers, most frequently see utilization opportunities in the economy (46.4% and 75.2% respectively). In the natural sciences, where no target group clearly stands out, citizens (37.8%) and politics (32.8%) follow closely behind.

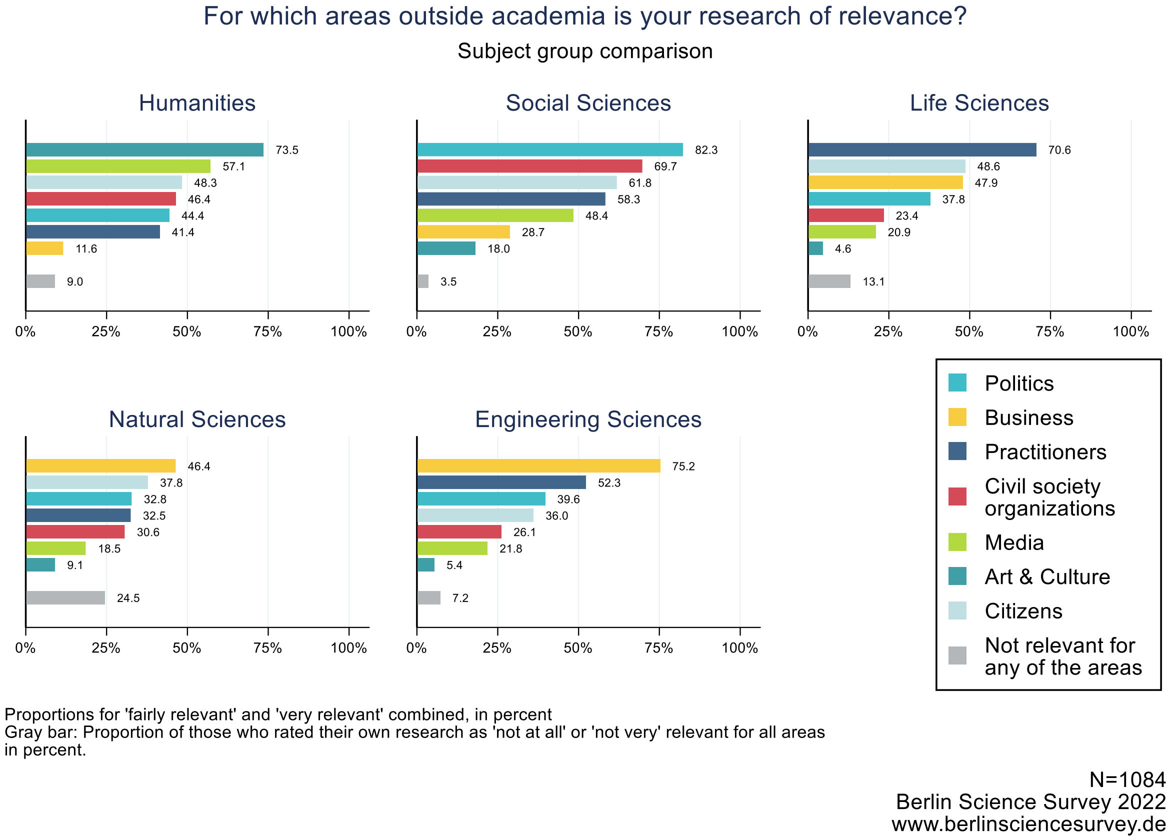

Figure 13 Relevance of research for non-scientific areas, by subject group

It should be noted that the relevance of their own research for various non-scientific areas of society varies depending on the subject group, but is rated quite highly overall. The proportion of those who do not consider their own research to be relevant to any area ("hardly relevant" or "not relevant at all") is also very low. Here, the proportion is still highest among natural scientists at just under 25% (see Figure 13). This is partly due to the fact that a large number of people in this subject group are involved in basic research, which in turn is more often considered irrelevant for non-scientific areas (not shown). Of all respondents who carry out basic research, 29.1% are from the natural sciences (not shown).

The fact that the relevance profiles differ depending on the type of knowledge produced is important both with regard to suitable science communication and to science policy control and support measures for a possible transfer of knowledge.

3.2 Exchange with relevant reference groups

In order to take a general inventory of the scientists involved in the exchange, the *Berlin Science Survey* followed up the relevance assessments by asking whether the scientists are in exchange with those social groups for which they consider their research to be relevant. This information, which is shown in Figure 14, can be understood as an indicator of the knowledge transfer that actually takes place and at the same time provides information on the degree to which a possible knowledge transfer potential has been exploited.

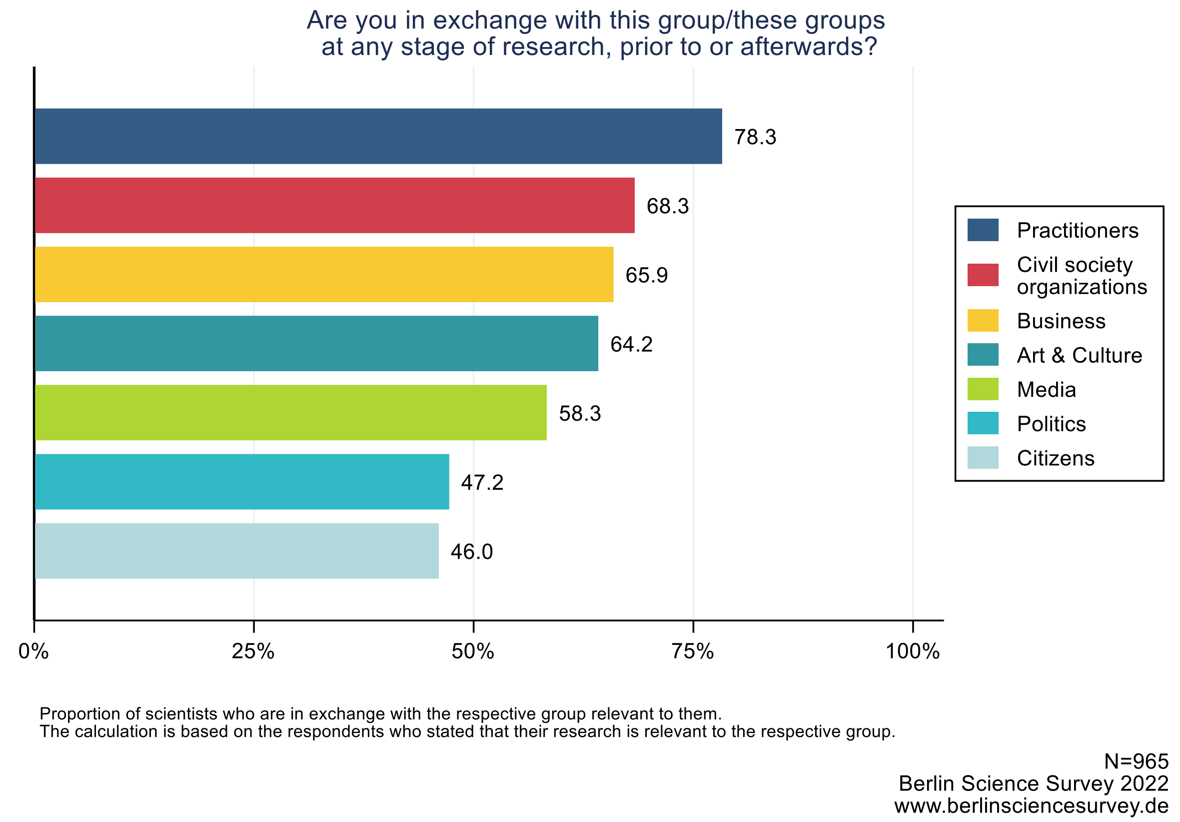

Figure 14 Exchange relationships with the relevant areas

An actual exchange is most widespread with practitioners as the relevant reference group (see Figure 14): Here, over 78% of respondents state that they are in exchange if their own research is considered "fairly" or "very relevant" for this group of people. Well over half of the respondents who consider research to be relevant for the media are also in contact with them (58.3%, Figure 14). The proportion is even higher for art and culture (64.2%), business (65.9%) and civil society (68.3%). Only in the reference groups of politics and citizens is the proportion of those who see their own research as relevant here and are also in contact with the groups below 50%. Nevertheless, the exchange is also quite high here at 47.2% and 46% respectively (see Figure 14).

3.3 Reciprocal knowledge transfer (timing of the exchange)

While in the early debates on knowledge transfer, this exchange was understood more as a unidirectional process of transferring finished knowledge, i.e. research results, to various actors in society, a concept of knowledge transfer is establishing itself in current debates that sees science in a stronger reciprocal exchange with society (Nowotny et al. 2001). This bidirectional or even multidirectional understanding of knowledge transfer emphasizes the interaction between science and different areas of society. Such an exchange can take place in various phases of the research process.

Interactions can take place before the actual research process, e.g. to obtain suggestions or insights from possible knowledge addressees and potential users into their understanding of the problem.

Interactions during the research process do not only include the now famous citizen science, in which citizens are involved, for example, in collecting mostly scientific data. It can also be strongly application and problem-solving related research that is carried out in close coordination with non-scientific partners, e.g. "practitioners". This includes translational research, e.g. in medicine, but also contract research for business and public institutions. Exchange after completion of the research process is often classic science communication, and therefore rather one-sided from a transfer perspective. However, the exchange can serve as a basis for further ideas and new research approaches if there is a discussion of the content of research results.

The new knowledge transfer survey instrument developed specifically for the Berlin Science Survey allows for a very detailed survey of such exchange processes. These phases in which exchange takes place - before, during or after the respective research process - were recorded. For the exchange during the research process, a distinction was also made as to whether the exchange took place during the planning of the research design, the implementation of the research, or the interpretation of the research results. Multiple answers were possible for all questions on the time of the exchange. The particular depth of detail in the survey allows conclusions to be drawn about the intensity and quality of the exchange. This survey instrument thus makes it possible to distinguish between a broader concept of knowledge transfer, which also includes (mere) scientific communication, and a narrower concept of transfer, in which the exchange takes place at the content level.

Figures 15 and 16 below show the phases of the research process in which an exchange takes place. It can be seen that exchanges in the various areas follow very similar patterns: Overall, exchanges take place significantly less frequently before the research process than during and after the research process. When answering the question about the timing of the exchange, multiple answers were possible, as exchanges can of course take place with reference groups at different times. Due to the multiple answers, the percentages can add up to over 100 %.

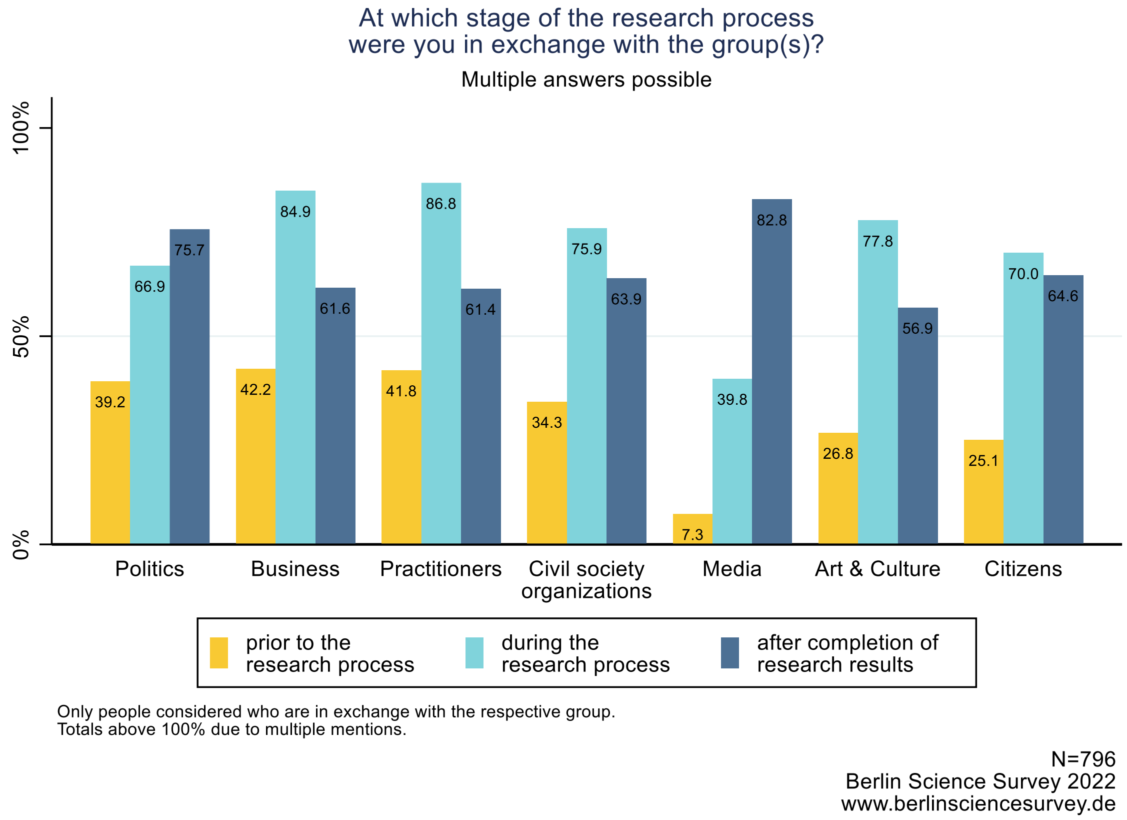

Figure 15 Exchange in the various phases of the research process

Figure 15 also makes it clear that the area of "media" has a special position in terms of exchange, as there is virtually no exchange before the research process. This is not surprising, as the media are only a source of research questions for very few research fields (such as media and communication studies). Rather, communication following the research process dominates the exchange with the media (83%). This is understandable, as the media utilize scientific findings. The situation is similar in the field of politics, where scientific findings are also utilized. Here, too, the exchange after the research process predominates (75%), although the exchange during the research process is also quite high (66%). The exchange with all other social reference groups takes place predominantly during the research process and is usually accompanied by an exchange until after the research process. The exchange with practitioners during the research process is particularly frequent (86.8%).

Figure 16 provides a more detailed breakdown of the exchange during the research process. This shows how often people interacted when developing the research questions, conducting the research or interpreting the results. When answering the questions, multiple answers were again permitted, so that the percentages can again add up to over 100%.

The special position of the media area is once again evident in this presentation: while interaction with all other areas mainly takes place during the research process, in the media area it only takes place during the interpretation and presentation of results. For all other areas, the exchange often already takes place during the development of the research question. This is particularly true for the exchange with partners from industry (61%) and with practitioners (50.6%). However, the exchange of knowledge with politicians, civil society institutions and the arts and culture also takes place at this early stage in around a third of cases. It is also noticeable that the exchange with practitioners and the economy takes place more frequently than in the other areas at several points during the research process. It can therefore be assumed that the exchange is not just selective, but continuous.

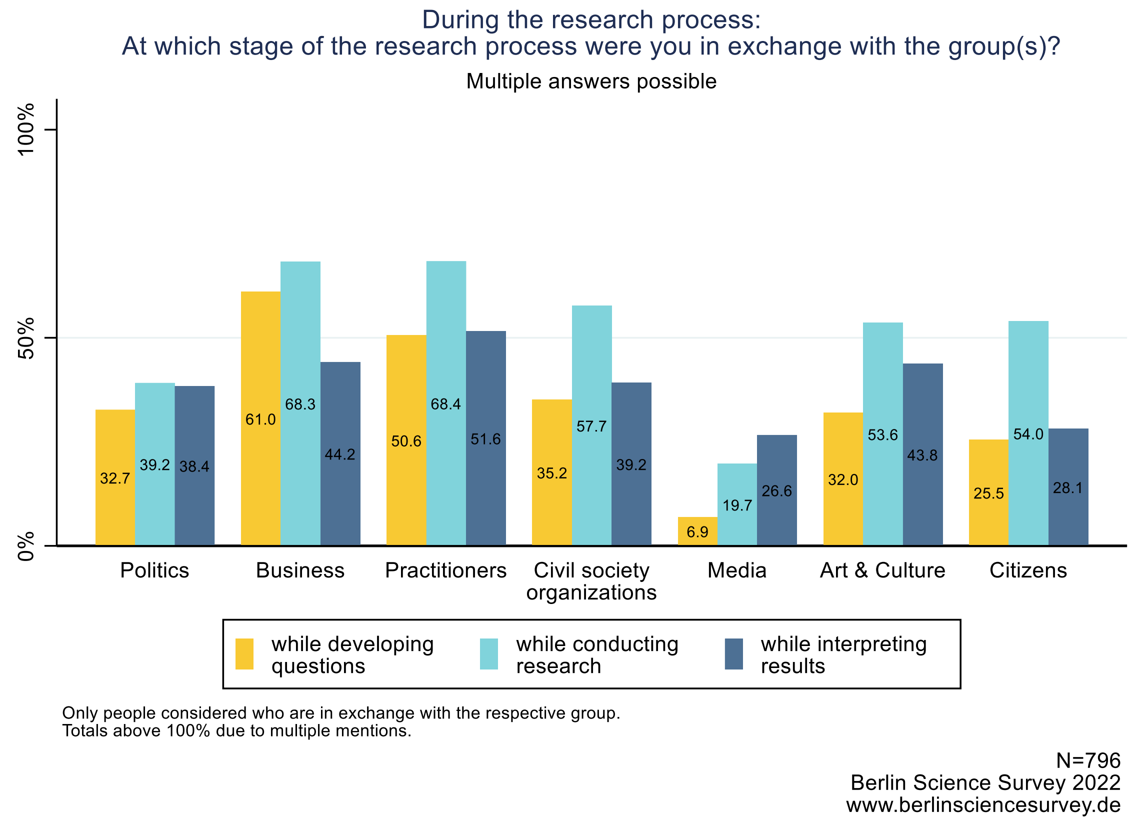

Figure 16 Exchange in the various phases during the research process

At status and subject group level, there are hardly any differences in the timeliness of exchanges with the respective relevant groups. Overall, professors interact slightly more (see Figure 17). At subject group level, it is primarily engineering academics who are most in contact with relevant groups before and during the research process (see Figure 18). This can be attributed to the higher cooperation rate with companies in this subject group (Lüdtke, Yankova, Ambrasat 2023).

As an interim conclusion, it can be stated that, on the one hand, exchange does not take place everywhere where research is considered relevant, but on the other hand, it is by no means possible to speak of so-called "research in an ivory tower". Exchange with relevant interest groups is quite widespread, and not only as downstream scientific communication, but to a considerable extent even before and during the research process.

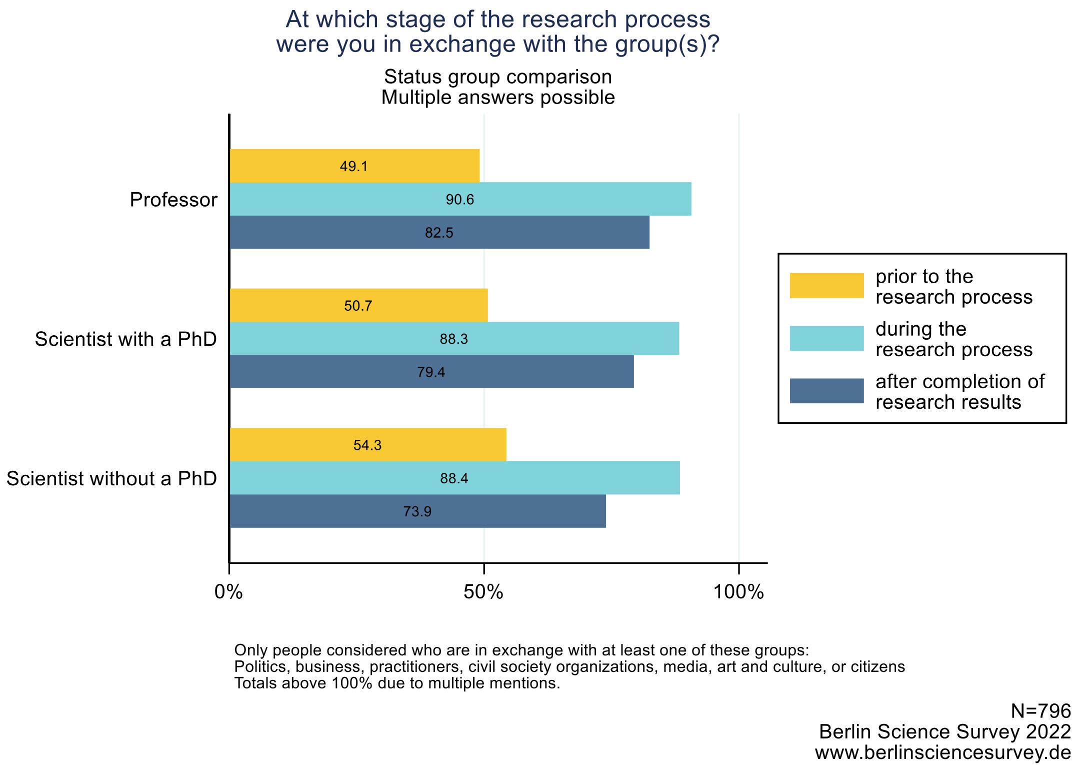

Figure 17 Exchange by phase in the research process, by status group

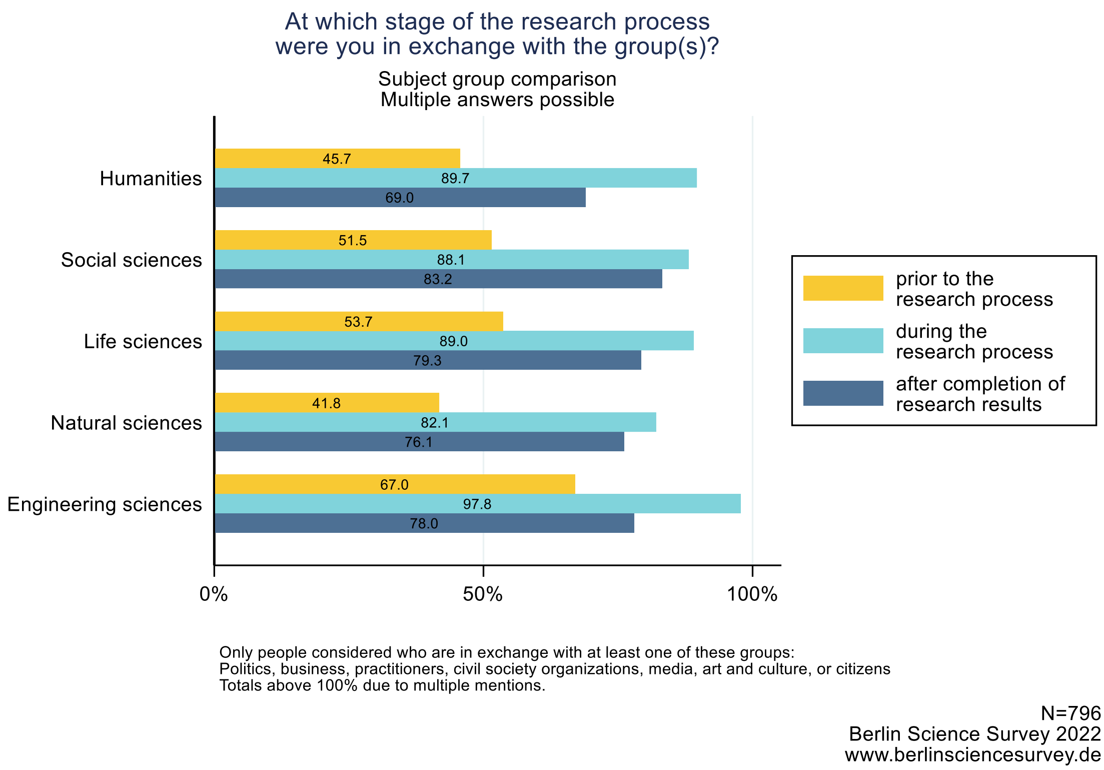

Figure 18 Exchange by phase in the research process, by subject group

4. Relationship between science & society

Science has a tense relationship with society. As academic research is largely publicly funded, it is under constant pressure to justify its achievements to society (Kaldeway 2013, Weingart 2001). However, this narrative is not only viewed critically, but is sometimes even pushed by science managers, with the risk of weakening the autonomy of science, which in turn is the basis for high-quality findings and innovations.

On the one hand, the demand for knowledge transfer is a good way of reminding scientists that they are ultimately working for society. On the other hand, there is a danger of aligning research too closely with current social problems and exploitation logics and thus missing out on innovations that are more likely to be sustainable in the longer term. This is a balancing act that must be balanced at the system level (by science policy) and the organizational level (university management). The responsibility for this cannot lie with the individual scientists. Nevertheless, the debates and discourses on the social utility of scientific results are also reaching scientists, and not only when the call for knowledge transfer has found its way into performance indicators. Even beyond implemented control and incentive mechanisms, scientists react sensitively to science policy imperatives. They may choose to respond because they hope to gain advantages in project acquisition or in their careers if they address new demands - such as societal impact - in their applications, and also because they themselves find some of the requirements useful and want to align their research with them.

It is therefore essential for us to survey the attitudes of scientists in addition to their practices. Attitudes reveal how scientists perceive and position themselves and their work in society. The survey of scientists is complementary to surveys of the population about their view *of* science (Science in Dialogue 2022).

In order to capture the attitudes of scientists towards the interrelationship between science and society, we focused on the following 3 central areas: the autonomy of science in relation to the social benefits of science, the participation of scientists in political debates, and the scientific-theoretical question of the status of scientific knowledge.

For the implementation of the questions in the questionnaire, we opted for two-sided, end-verbalized scales - so-called semantic differentials. These compare two discourse positions and allow respondents to be assigned to one or the other position. At the same time, agreement with the positions can be ascertained in graduated stages.

4.1 Autonomy of science

Figure 19 illustrates the attitudes of the scientists surveyed with regard to the question of whether science should "maintain a high degree of autonomy from societal demands" or "place itself at the service of society". While a total of 45% (tend to) support a high degree of autonomy from society, slightly fewer respondents (38.7%) agree that science should place itself at the service of society (see Figure 19). The scientific community is therefore divided on this issue. One sixth of respondents have a neutral position here and have not assigned themselves to either of the two positions.

Figures 20 and 21 show the comparison of status and subject groups with regard to attitudes towards autonomy in science. According to this, professors, natural scientists and humanities scholars tend a little more towards the autonomy position, while the other status and subject groups are more in the middle category and therefore cannot or do not want to position themselves more clearly here.

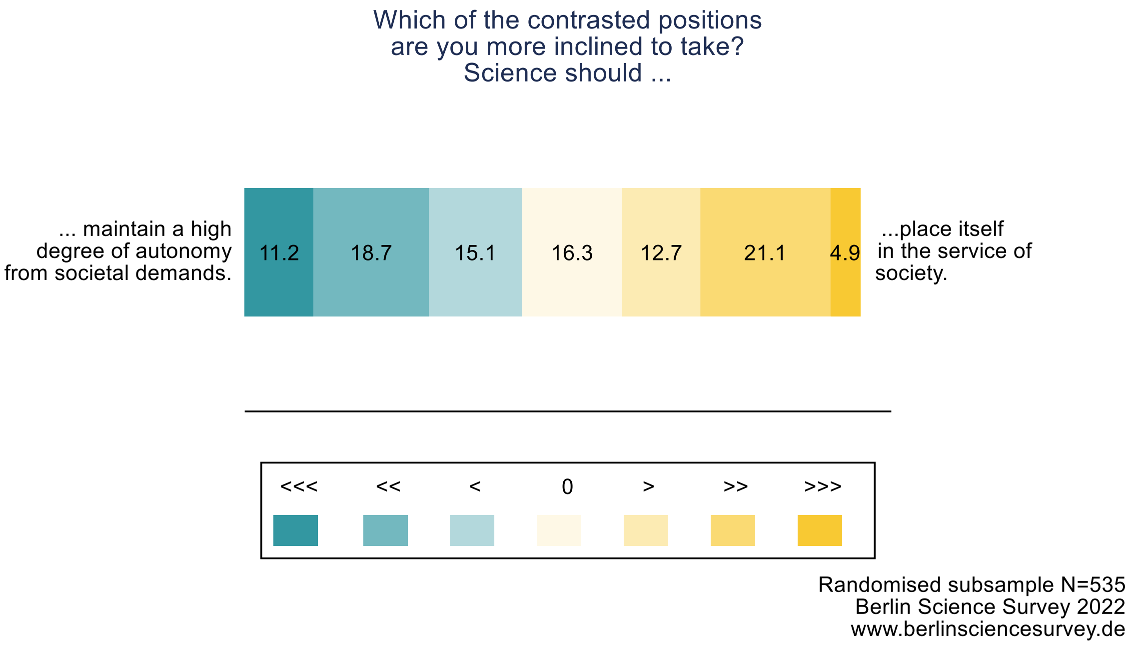

Figure 19 Attitudes towards autonomy in science

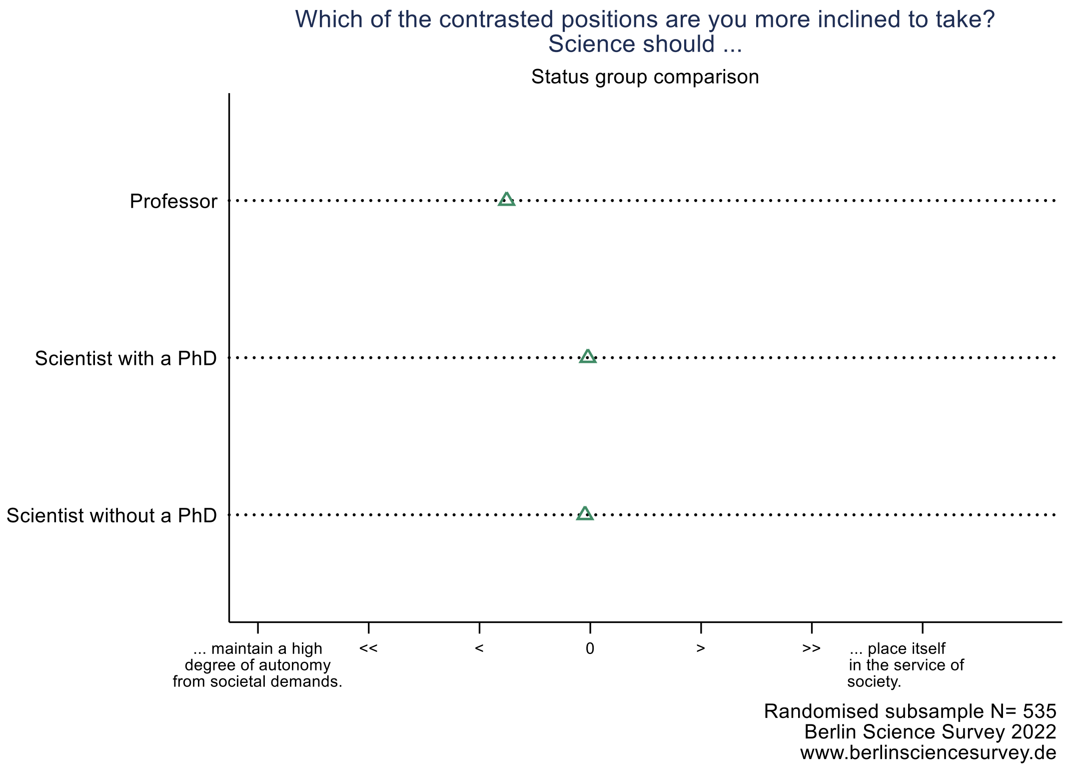

Figure 20 Attitudes towards autonomy in science, by status group

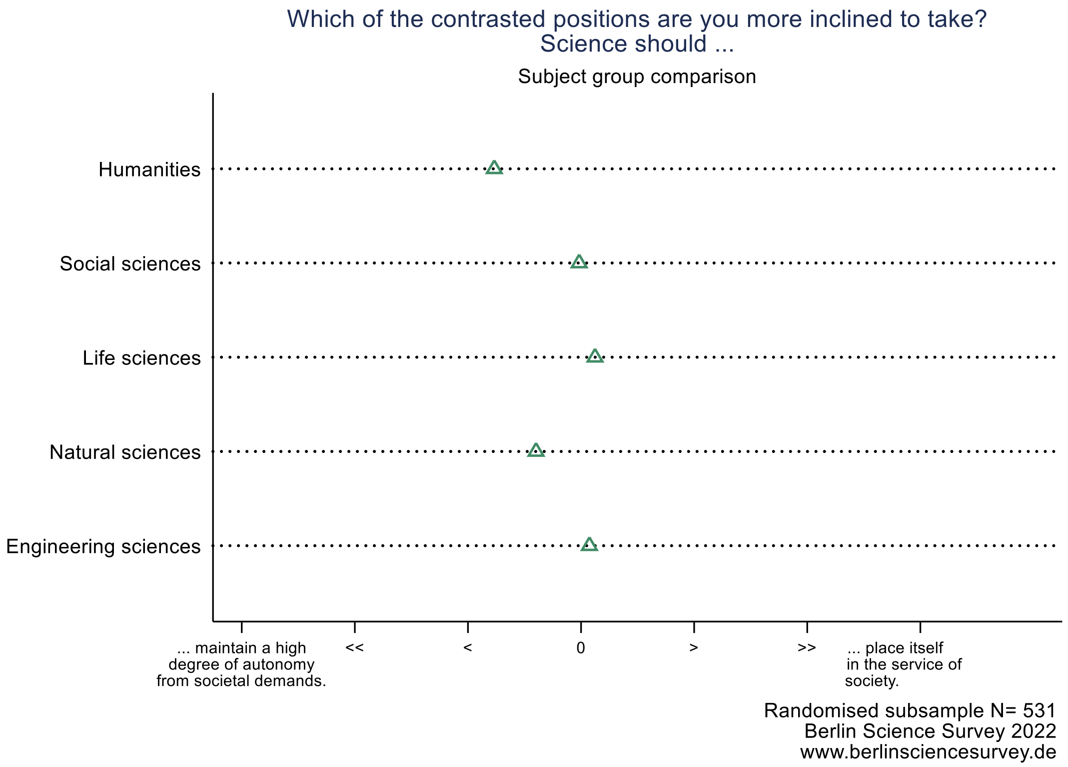

Figure 21 Attitudes towards autonomy in science, by subject group

4.2 The role of scientists in public debates

The second attitude survey focuses on the behavior of the scientists themselves and the question of their involvement in public debates. For this purpose, we formulated two positions with respective counter-positions on which the respondents were asked to take a stand (see Figure 22).

While respondents were divided on the topic of autonomy in science, there was a greater consensus here: at 82.5%, the absolute majority of respondents believe that scientists should be actively involved in public debates, while only just under 8% believe that scientists should stay out of them. Only 9% of respondents did not take a position or were undecided. This picture clearly shows how much scientists believe in the importance of the knowledge they produce for politics and society. Furthermore, it could also be an expression of the perception that although politics and society have a need for scientific knowledge, this is currently not sufficiently considered.

When scientists appear in public as "experts", it makes a big difference whether they limit themselves exclusively to their research and professional expertise or whether they - similar to public intellectuals - also comment on topics that go beyond their research. The media and, to some extent, politicians respond positively when individual scientists take on a broader expert role. We want to find out what the scientists themselves think about this. That is why we also asked: should scientists limit themselves to statements about their own research or should they also contribute to topics that go beyond this?

The response pattern is again relatively clear, although not quite as clear as before. Overall, 62.7% of respondents believe that scientists should limit themselves to their research topics. Of the respondents, 27.2% believe that scientists should get involved in public debates on topics beyond their own research and just under 10% had no or a neutral position on this.

Scientists therefore want science to have a strong voice in public debates. However, the expertise of the respective scientist and the resulting appreciation by politics and society should not be unnecessarily strained by statements that are not based on their own expertise.

There are no relevant differences between the status groups (see Figure 23). The subject groups also did not differ when it came to the question of involvement in public debates. With regard to the question of limiting their own statements, social scientists and engineers tend to be more inclined than the other subject groups to believe that they should limit themselves to statements on their own research topics (see Figure 24).

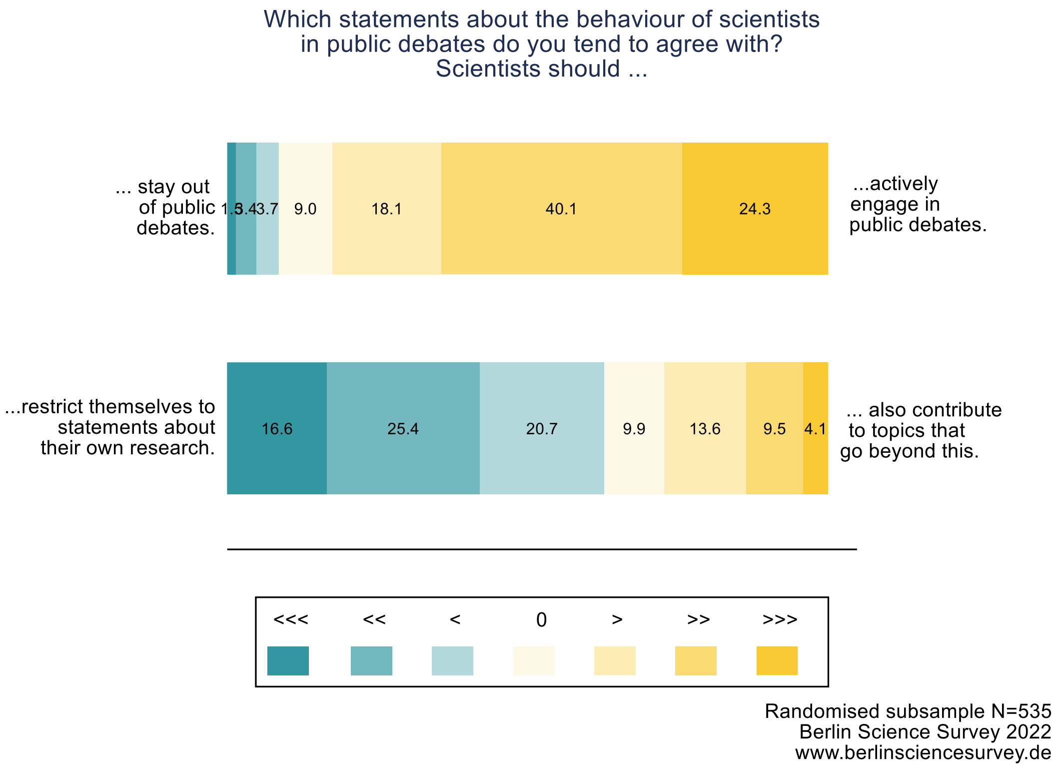

Figure 22 Attitudes towards scientists in public debates

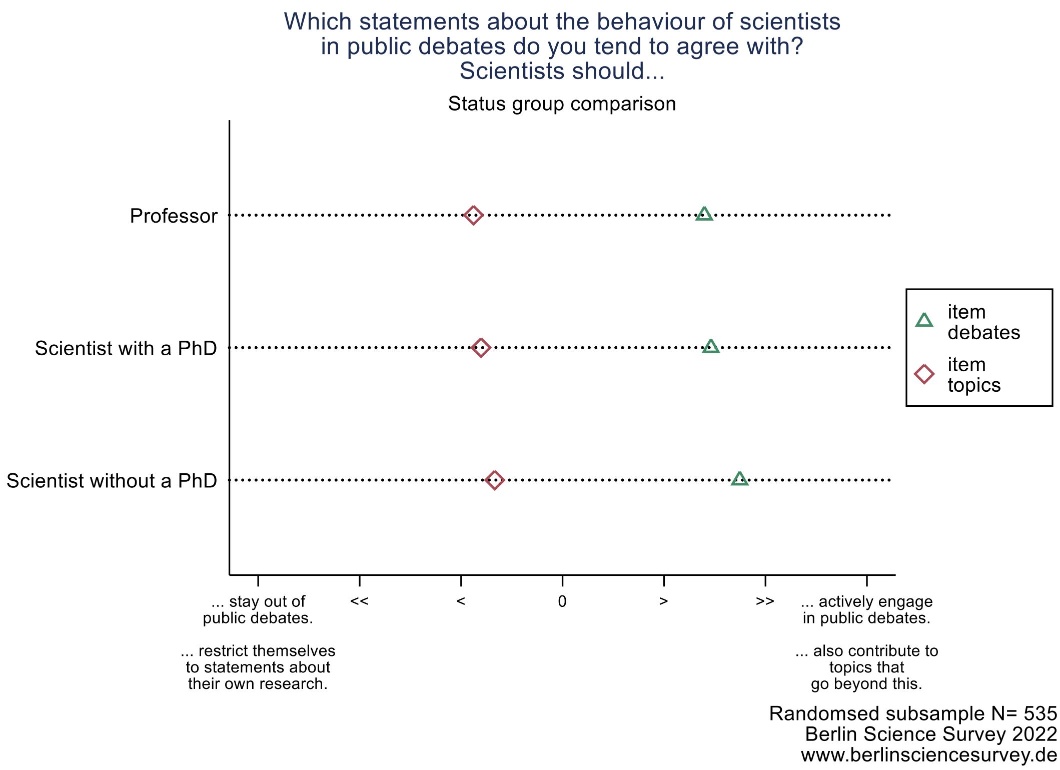

Figure 23 Attitudes towards scientists in public debates, by status group

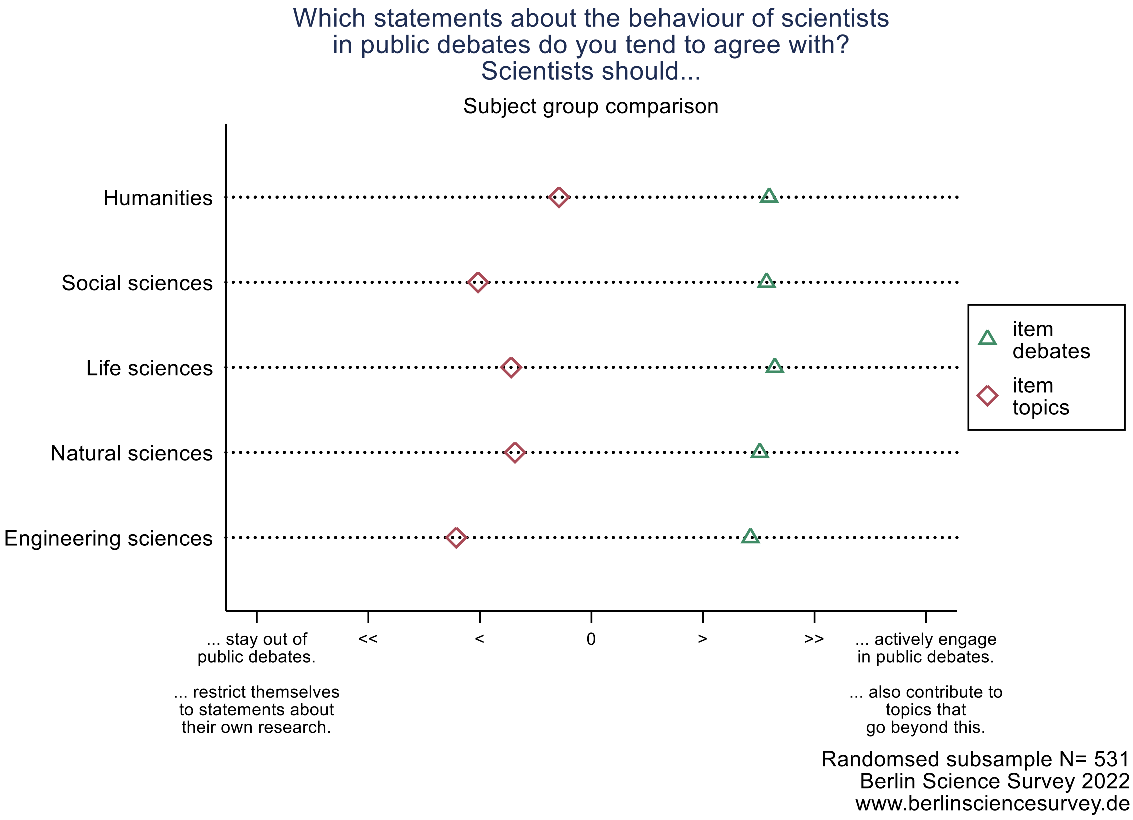

Figure 24 Attitudes towards academics in public debates, by subject group

4.3 The status of scientific knowledge (value & objectivity)

In April 2017, hundreds of thousands of scientists around the world took part in the March for Science to make the case that scientific knowledge is non-negotiable (see, for example, https://marchforscienceberlin.de). This was preceded by numerous political debates in which scientific knowledge was questioned and contrasted with alternative facts. As a result, the question of the status of scientific knowledge gained greater attention and became a subject of discussion. Even within the scientific community, there is no uniform understanding of the status and methodological characteristics of scientific knowledge. Against the background of recent debates, we have selected two classic points of contention in the theory of science regarding the status of knowledge: on the one hand, the question of the value-free nature of scientific knowledge, following Max Weber, and on the other, the question of its objectivity (Weber 1968). The positions are as follows:

> A: Scientific knowledge is in itself value-free, it depends on what politics and society make of it.

> B: Scientific knowledge is not in itself value-free, but suggests certain courses of action.

Empirical evidence shows that the scientists surveyed actually disagree on this question (see Figure 25). For example, 35% of scientists (tend to) agree with the position that knowledge is intrinsically value-free and that it depends on what politics and society make of it. In contrast, 55.4% do not consider scientific knowledge to be value-free, but rather to guide action. Just under 10% did not take a position here.

The positions on objectivity were as follows:

A: Scientific knowledge is open to interpretation and always provisional.

B: Scientific knowledge is objective and universally valid.

Empirically, this shows that a majority of 56.7% do not support the classic idea of objectivity and universality of scientific knowledge, but (rather) agree with the statement that scientific knowledge is always provisional and open to interpretation. Nevertheless, 27.3% are still committed to the objectivity and universality of scientific knowledge. A fairly large proportion of 16% did not take a position on either side of this question.

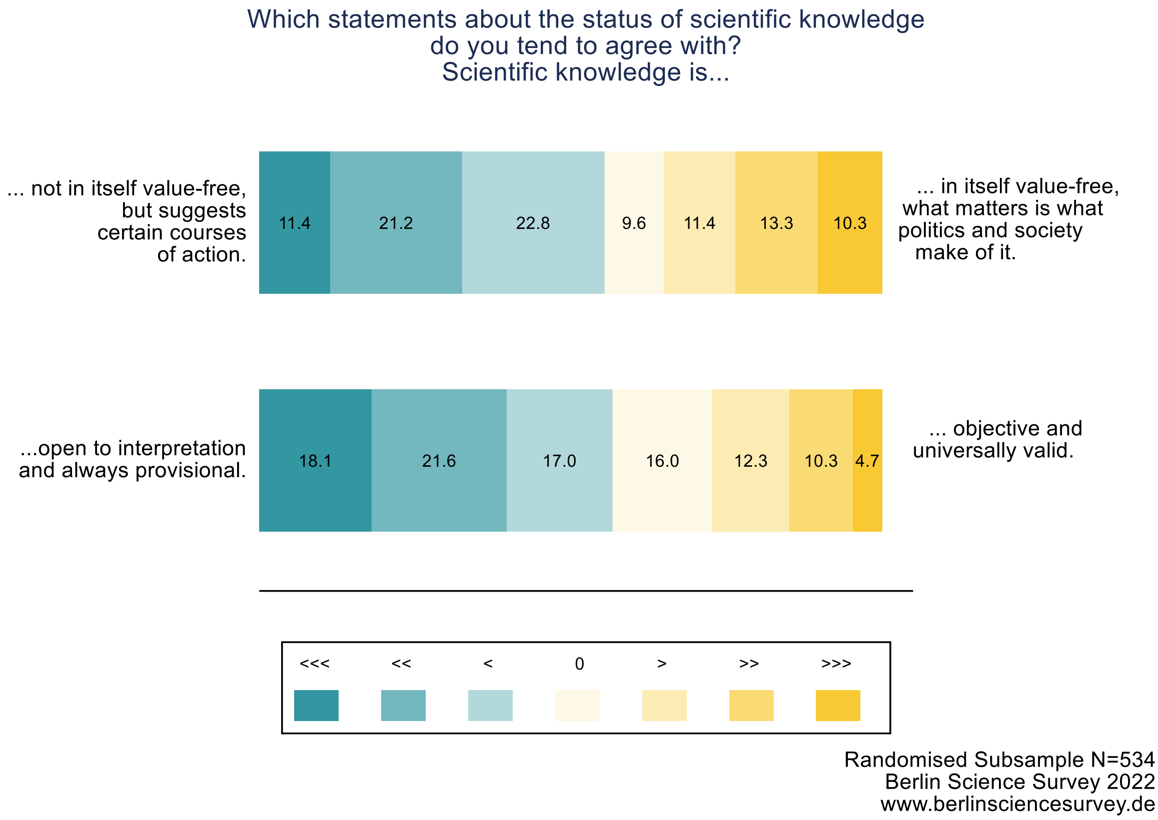

Figure 25 Attitudes towards scientific knowledge

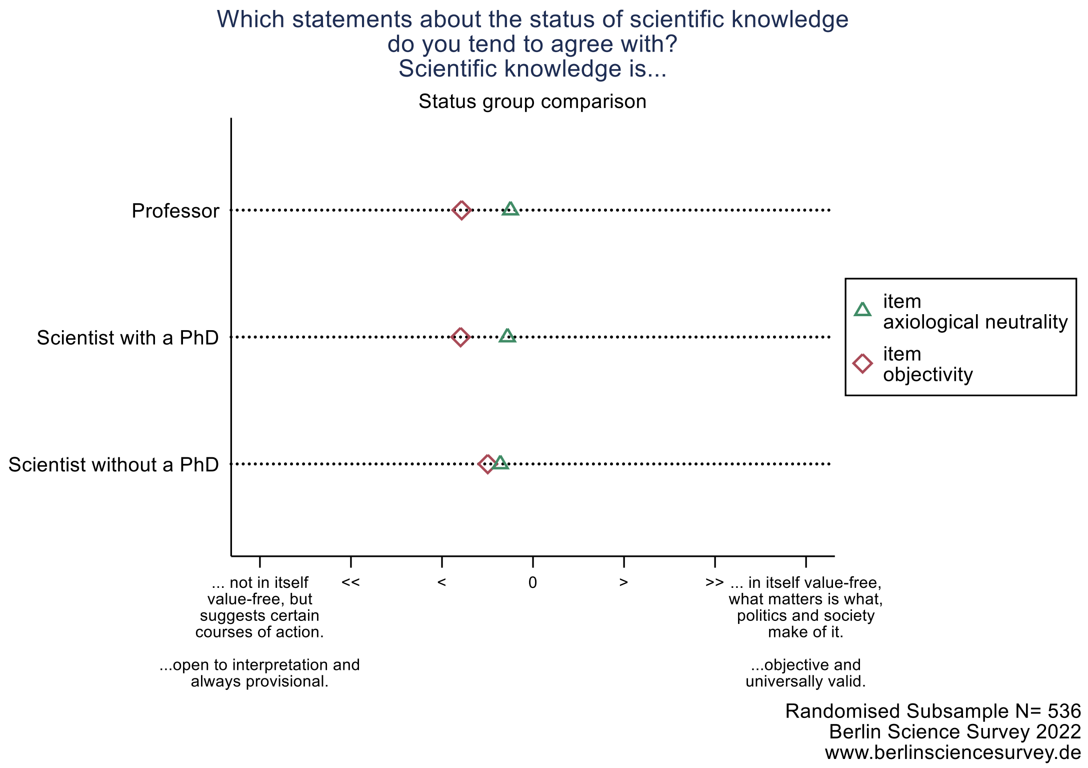

Figure 26 Attitudes towards scientific knowledge, by status group

Figure 27 Attitude towards scientific knowledge, by subject group

The status group comparison (Figure 26) shows that there are no differences between professors, postdocs and pre-docs in the two methodological questions on the status of academic knowledge. On the contrary, classic subject boundaries are visible in this question (see Figure 27). For example, humanities scholars and social scientists are less likely to agree with freedom of value and view knowledge as less objective and much more often as open to interpretation and provisional. This reflects the classic contrast between the "two cultures" (Snow 1959) - the natural sciences on the one hand and the humanities on the other - and shows that individual judgments are strongly derived from the respective professional perspective.

5. Connections between research practice & attitudes

In order to find out whether the different attitudes or positionings are dependent on certain influencing factors, we estimated multivariate logistic models. This is used to examine the extent to which attitudes towards autonomy (Fig. 28), the role of scientists in debates (Fig. 29, 30) and views on scientific knowledge (Fig. 31, 32) can be traced back to membership of a particular subject group or status group, gender or characteristics of the research context. Figures 28 to 32 show the results.

With regard to the question of how autonomous science should be in relation to societal demands, there are several strong effects (see Figure 28). For example, professors are more in favor of the autonomy of science, while younger scientists are more inclined to the position that science should serve society.

Women are also slightly more likely to affirm the service function of science towards society. This is an important finding, as the model already controls for variables that are confounded with gender, such as subject group and status. It is therefore a genuine gender effect.

With regard to the subjects, the multivariate model shows slight changes compared to the bivariate findings: Life scientists and engineers are significantly more likely to see science as serving society compared to social scientists. The effects of the subject groups are less strong in this model compared to the bivariate correlations, as epistemic conditions of research are also considered here, which explain part of the subject variance (see Figure 28).

Three complementary findings can be found for the epistemic conditions: Scientists who work more theoretically, but also those who are dependent on technical infrastructures, emphasize the autonomy of science more strongly. Respondents who work in research contexts with high competition from other research groups tend to favor the position that science should serve society (see Figure 28).

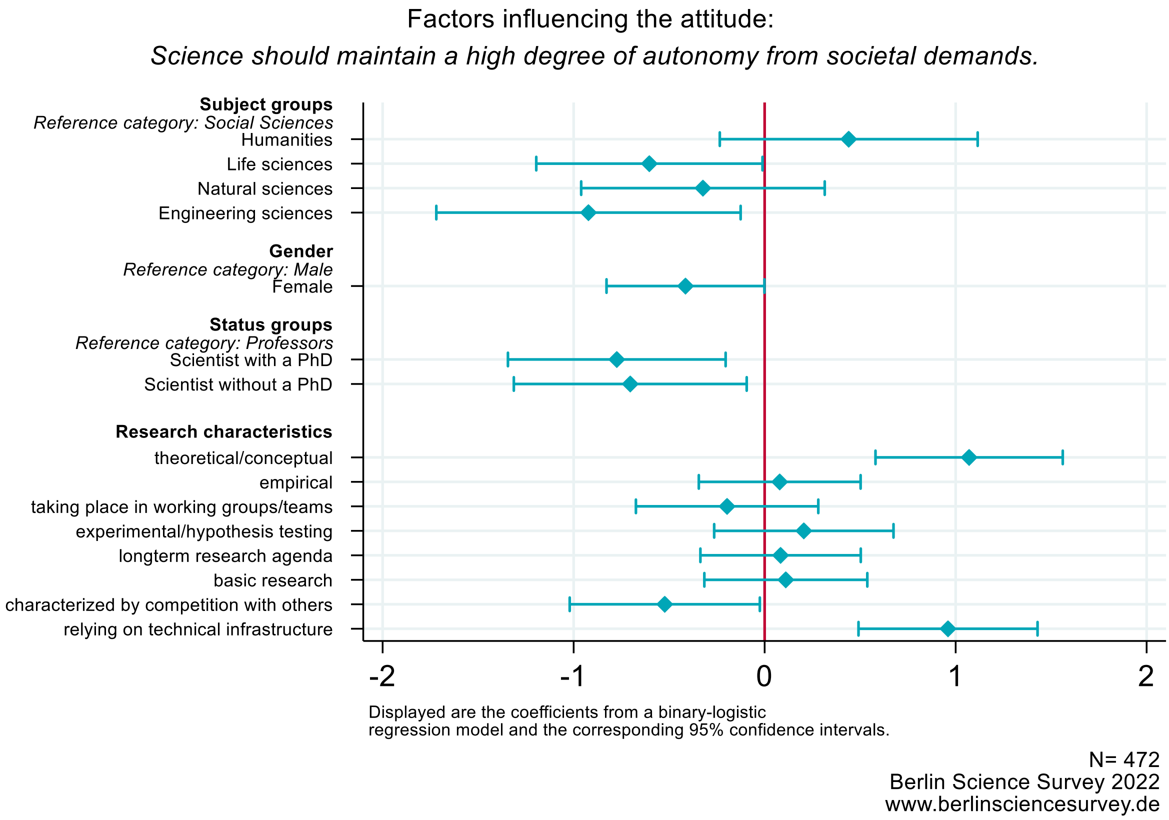

Figure 28 Factors influencing attitudes: Autonomy

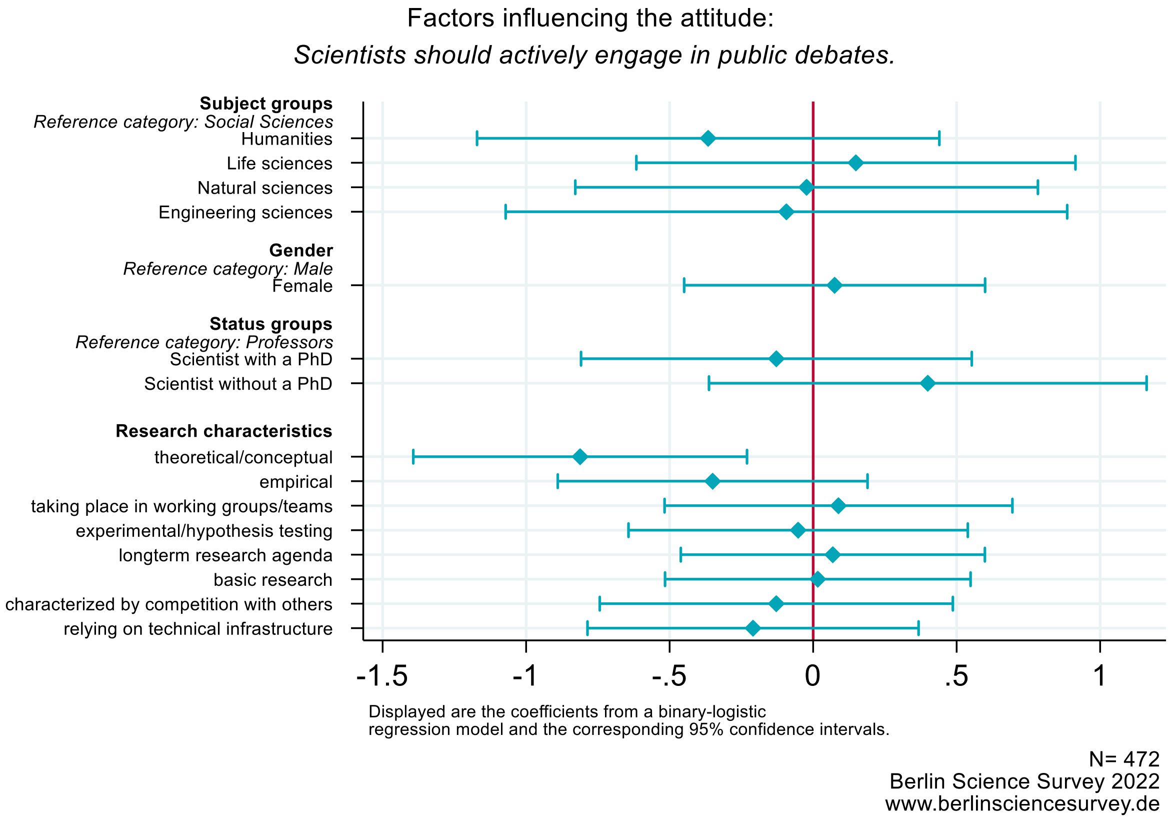

Figure 29 Factors influencing attitudes: Engagement in public debates

Figure 29 illustrates that only one epistemic characteristic has a significant influence on the position of scientists' involvement in public debates: those who essentially work theoretically / conceptually tend more towards the position that scientists should stay out of public debates.

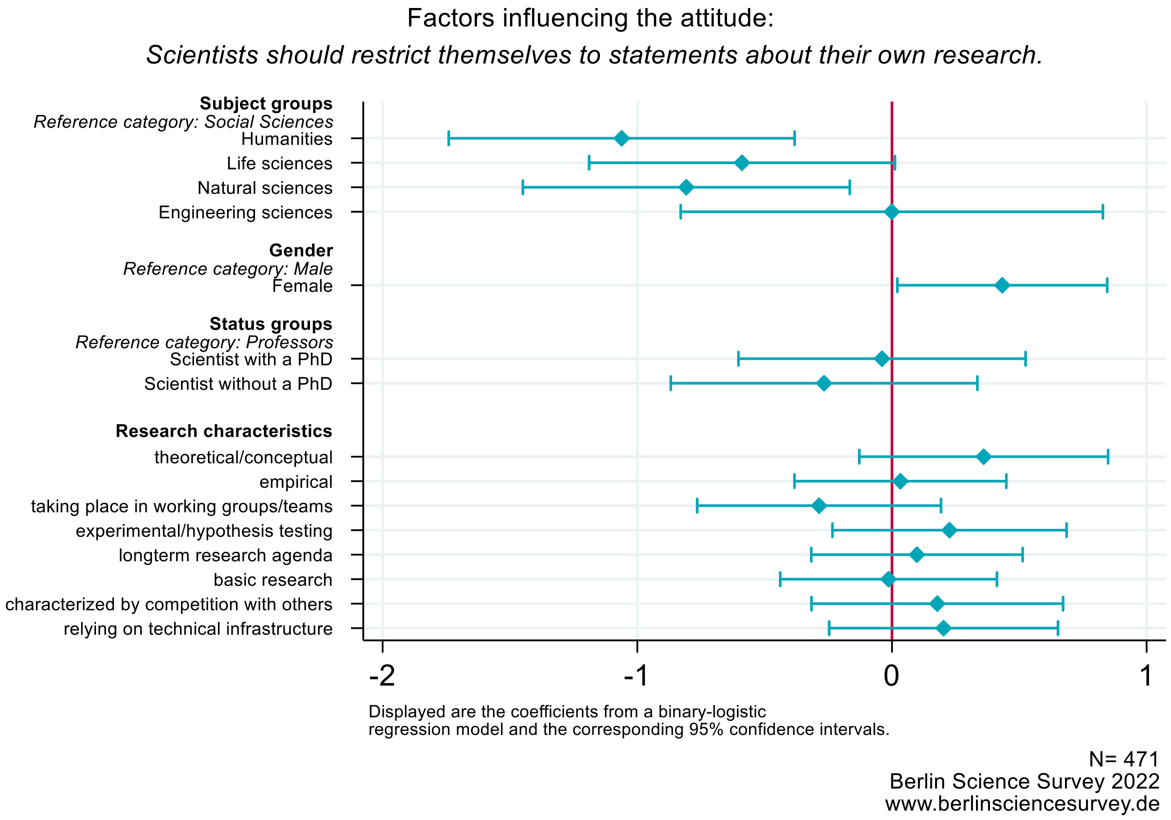

Figure 30 Factors influencing attitudes: Restriction of statements

There is also a significant gender effect with regard to the question of whether scientists should only comment publicly on their own research topics or also on other topics (see Figure 30). Here, it is women who are significantly more likely to think that scientists should limit themselves to statements on their own research topics. In addition, scientists from the humanities, life sciences and natural sciences are more inclined to comment on topics that go beyond their own research topics compared to those from the social sciences.

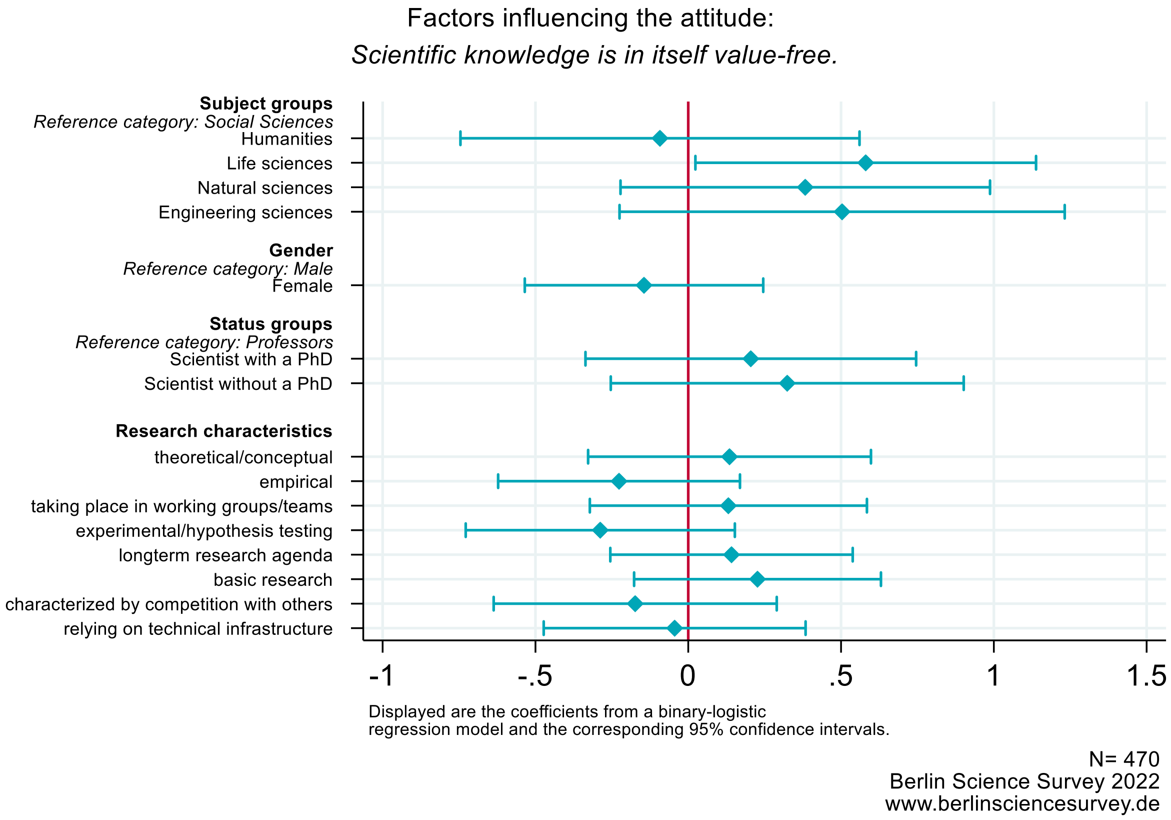

Figure 31 Factors influencing attitudes: Axiological neutrality

Figure 31 shows that the attitude towards the value freedom of knowledge cannot be significantly explained by any of the characteristics tested. This means that the variance here cannot be traced back to structural or contextual characteristics and therefore tends to reflect subjective, individual positioning.

Figure 32 illustrates that life scientists, natural scientists and engineers agree significantly more often with the position that knowledge is objective and universally valid compared to social scientists. In contrast, scientists whose research is characterized by strong competition with other research groups are more likely to agree with the position that knowledge is always open to interpretation and provisional (see Figure 32).

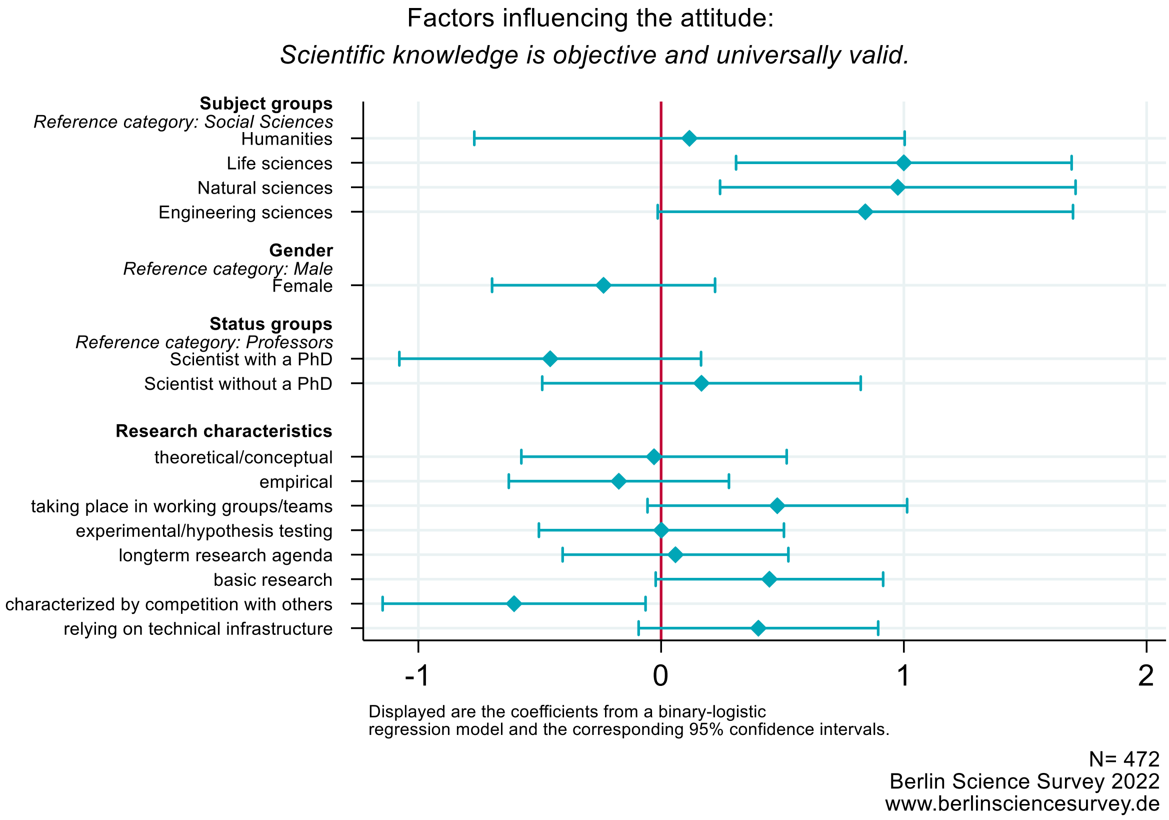

Figure 32 Factors influencing attitudes: Objectivity

6. Institutional conditions for the implementation of knowledge transfer

As the BUA would like to promote knowledge transfer in the Berlin research area, the question arises as to where exactly funding can be effectively applied. In the BSS, we asked to what extent there is currently a need for support from the institutions in the area of knowledge transfer.

The expressed need for support must be considered in the context of other assessments, such as the previously examined transfer potential on the one hand and how the Berlin research area is already positioned in terms of knowledge transfer on the other. We also asked the researchers for their opinions on this.

6.1 Assessment of the Berlin research area with regard to knowledge transfer

In order to evaluate the framework conditions in the Berlin research area, the researchers were asked to assess the Berlin research area with regard to various aspects (Lüdtke and Ambrasat 2022a). Compared to the other topics, a relatively large number of respondents (18.6%) stated that they were unable to assess the topic of knowledge transfer for the Berlin Research Area (not shown). These are predominantly pre-docs, i.e. tend to be less experienced researchers who are not (yet) able to assess the Berlin research area so well. Of all those who provided an assessment, 55% rate the Berlin research area as "rather well" positioned in terms of knowledge transfer and 11.4% even as "very well" positioned. On the other hand, a third of respondents were critical of the Berlin Research Area in terms of knowledge transfer and rated it as "rather poor" or even "very poor" (see Figure 33).

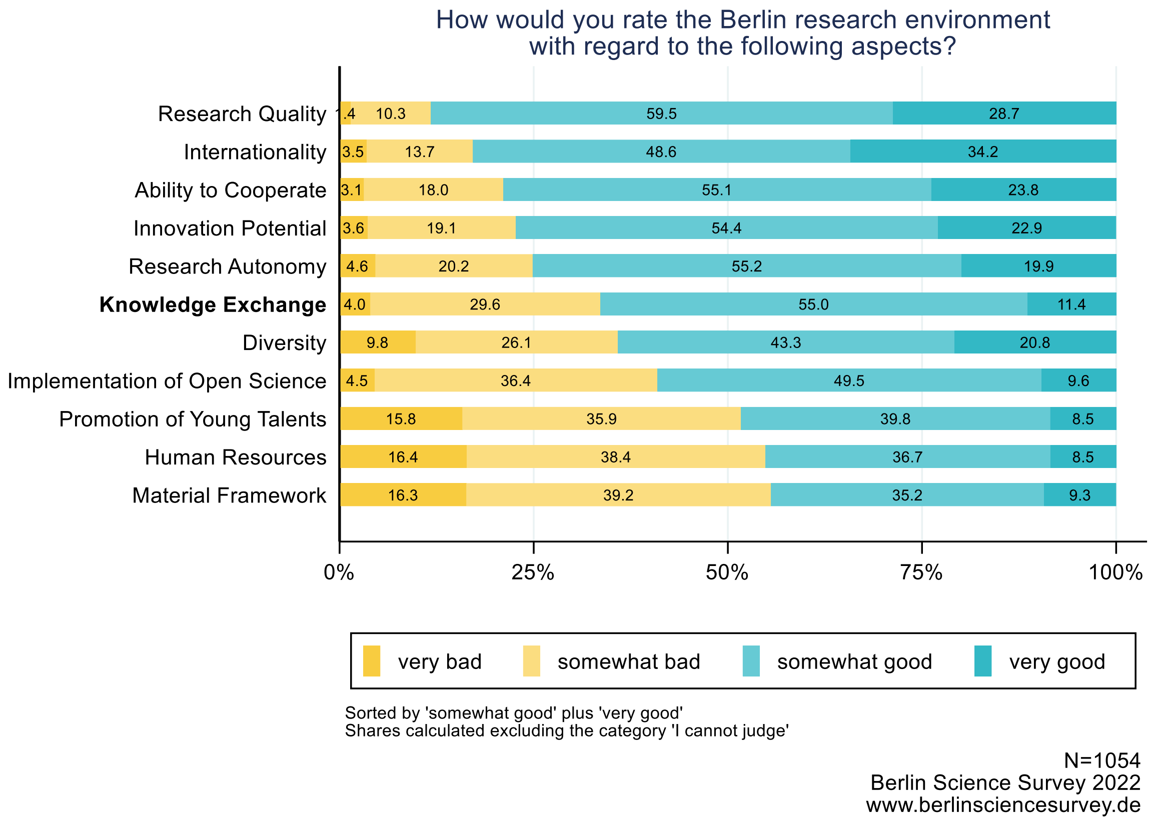

Figure 33 Assessment of the Berlin research area

6.2 Need for support from the facilities

The literature on so-called heterogeneous collaborations shows that tensions can arise when actors with different knowledge and experience backgrounds and possibly different interests enter into an exchange (Gläser et al. 2004). If possible, such tensions should not become a burden for the individual scientists, let alone make transdisciplinary cooperation or knowledge transfer activities impossible.

The question of the need for support in knowledge transfer activities serves to obtain indications as to whether and where science management should intervene. It should be noted that a quantitative survey study can only provide initial indications, while supplementary qualitative studies or concrete exchanges with individual research groups can only provide information on where and how specific support and funding should be provided.

A remarkable 46% of all respondents would like more support from their institution when it comes to knowledge transfer (not shown). Younger researchers are significantly more likely to express a need for support in knowledge transfer than more established researchers. Broken down by status group, 37% of professors, 45% of postdocs and 50% of predocs indicated a need for support (see Figure 34). It seems plausible to assume that less experienced researchers have a correspondingly higher need for support. On the other hand, it could also be that the younger ones report a greater need for support because they find the topic more important (see Fig. 4 above) and want to make progress on it. We examine the effects below (Figure 36) in a multivariate model.

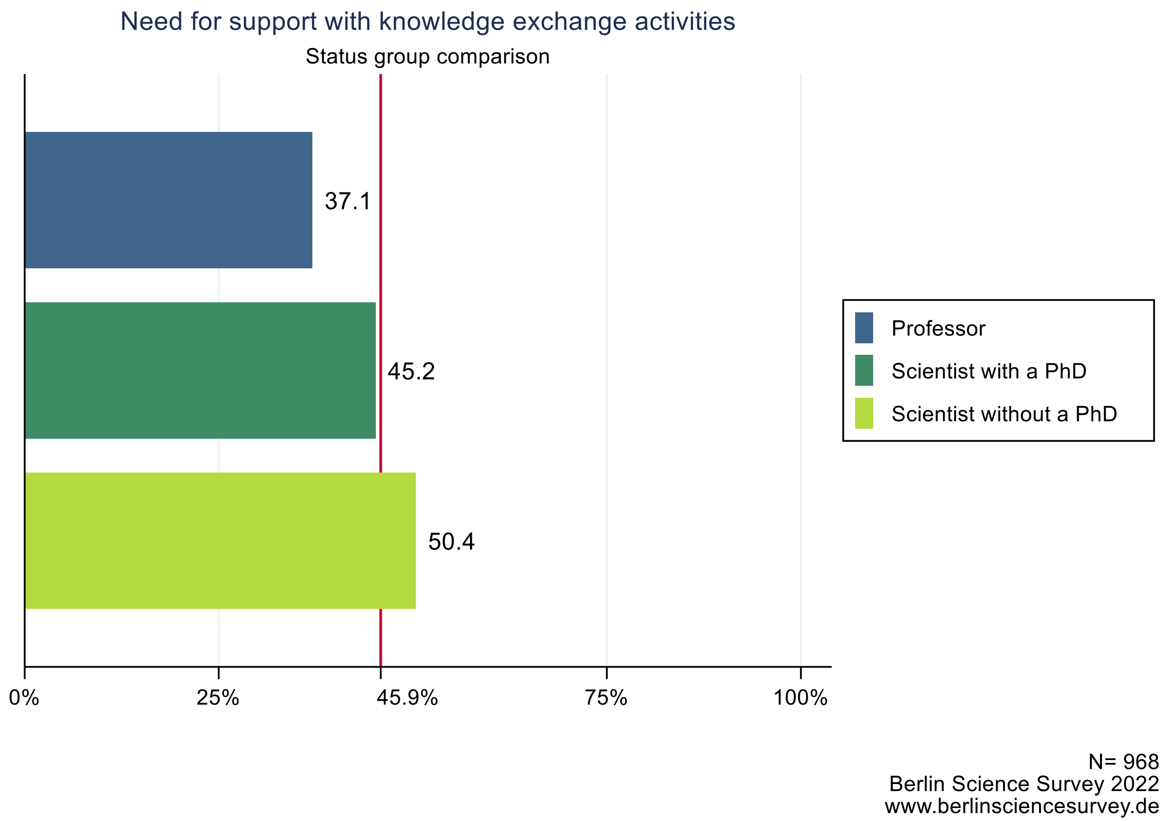

Figure 34 Need for support with knowledge transfer activities, by status group

A comparison of the subject groups shows hardly any significant differences (see Figure 35). Only in the natural sciences is there a slightly lower need for support (41%) than in the other subject groups, where the proportions are between 46% (life sciences) and 49% (social sciences).

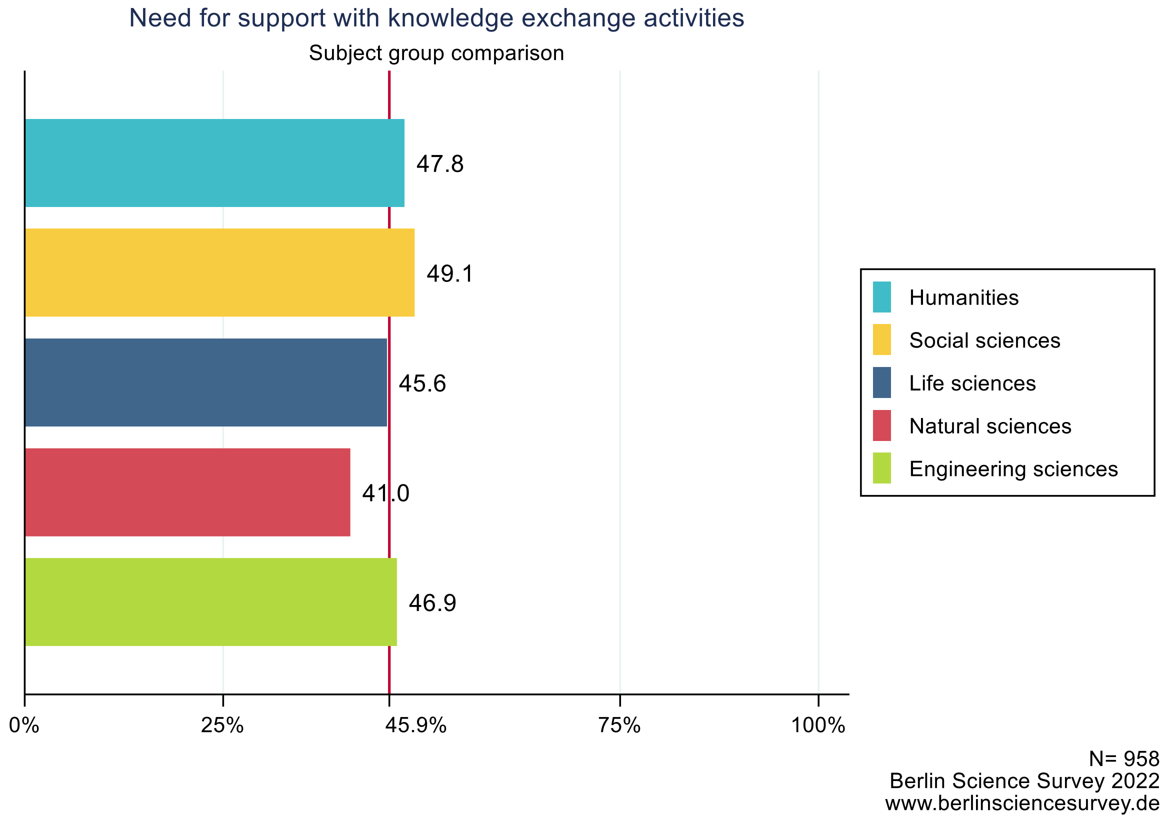

Figure 35 Need for support in knowledge transfer activities, by subject group

Overall, the stated need for support is surprisingly high considering the already existing exchange and could also indicate that the researchers feel pressured when it comes to transfer and would like to pass responsibility back to the institutions. Another explanation could be that although the scientists are generally positive about knowledge transfer, they perceive some hurdles in practice that they feel are a burden. In the multivariate model, we also looked at the factors influencing the need for support. In fact, it is not a high level of expectation pressure, but rather their own normative objectives that make the topic of knowledge transfer urgent and thus create a need for support (see Figure 36). This means that it is primarily those who consider knowledge transfer to be an important goal in science who also claim a need for support from their institutions. Furthermore, the bivariate finding shows that early career researchers have a greater need for support.

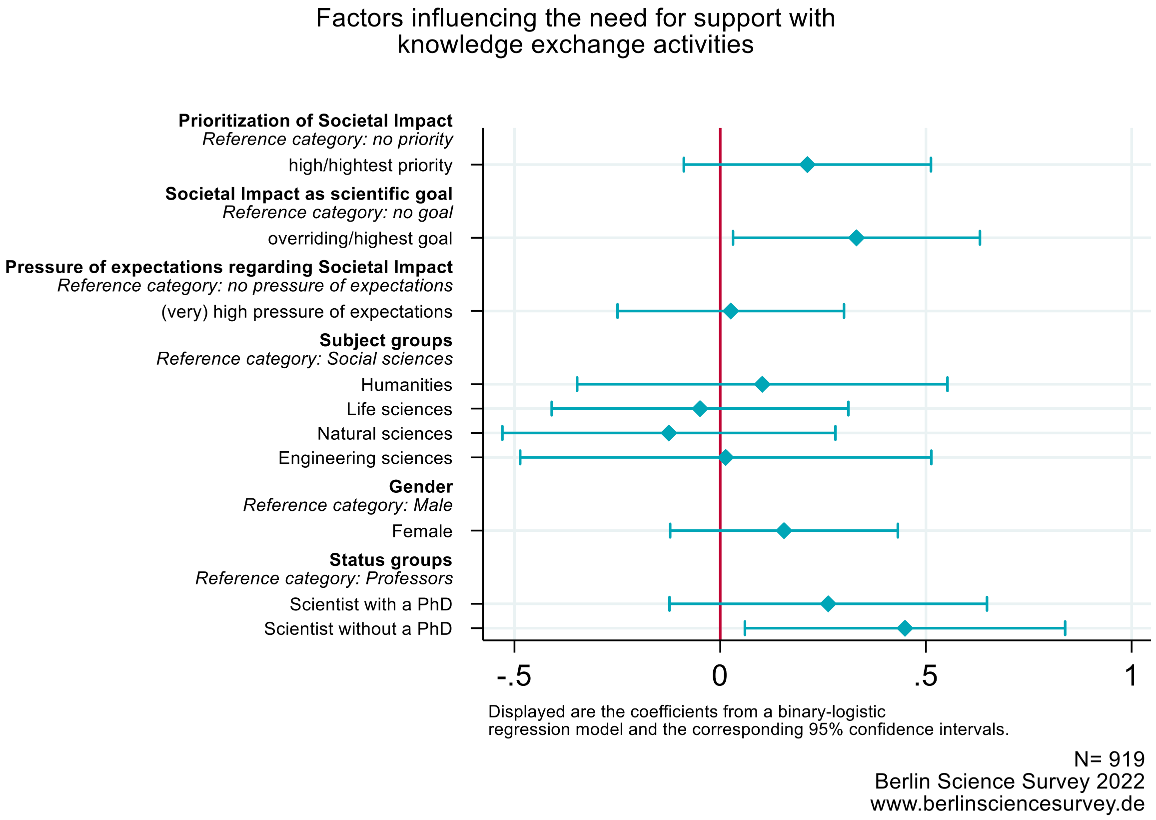

Figure 36 Factors influencing the need for support in knowledge transfer activities

7. Conclusion and outlook

This focus report examined the topic of knowledge transfer on three levels. Firstly, it looked at scientists' assessment of the institutional conditions in the Berlin research area. In addition, various attitudes of scientists towards the relationship between science and society were surveyed. A third focus was the assessment of the extent to which scientists in the Berlin research area are already involved in knowledge transfer processes. Here, we used a new research tool that shows in which phases of the research process there is an *exchange* with *relevant* groups in society.

General conditions in the Berlin research area

The survey on the framework conditions showed that the majority of scientists believe that the Berlin research area is well positioned with regard to knowledge transfer. Over 66% state that the implementation of knowledge transfer is "rather good" or even "very good". At the same time, almost 46% of respondents would like more support in implementing knowledge transfer. Young researchers in particular indicated this need. It can be assumed that appropriate measures on the part of the institutions can meet such needs. In addition, it has been shown that scientists who are particularly concerned about the social utility of research results would like more support in knowledge transfer from their institutions.

However, it must also be acknowledged that in the context of the diverse tasks and objectives in science, the social utility of the knowledge produced is rated rather low by the scientists themselves. Although more than half of those surveyed stated that "societal impact" should be a "high" or even one of the "highest goals" within science, at the same time, more than 41% of those surveyed felt a "high" or even "very high" pressure of expectation on the topic. However, the social utility of research in their own scientific practice tends to be given lower priority. A good 53% of those surveyed gave this goal "no" or only a "low priority". The third mission does not have the same priority for individual scientists as it does for the organizations that have adopted this social mission for themselves. The individual scientists, on the other hand, feel overburdened in some cases. It can be deduced that it is not expedient for organizations to pass this goal on to scientists in a linear fashion as requirements, as is often the case when implementing performance criteria and incentives. Rather, an organizational strategy for knowledge transfer is needed in which the organization bears the main responsibility and involves the scientists only selectively, in a targeted manner, while at the same time providing them with framework conditions and a set of tools that effectively and efficiently support their own activities.

Attitudes towards the relationship between science and society

The absolute majority of respondents (83%) believe that scientists should actively participate in public debates. However, 63% of respondents believe that they should limit themselves to making statements about their own research. Just under 28%, on the other hand, believe that scientists should also contribute to public debates beyond this. This shows that while scientists consider it necessary to contribute scientific expertise to social discourse, this contribution is interpreted not in the sense of public intellectuals, who express themselves much more broadly, but rather with clear reference to the knowledge they have produced themselves. It is unclear whether the interviewees see more of a danger here that the "expert status" of scientists could be devalued if they also comment too often on other topics, or whether they do not trust (other) scientists to be able to contribute competently to public debates on topics outside their field.

The importance of the autonomy of science is controversial in the scientific community: While 45% are in favor of science retaining a high degree of autonomy from society, hardly any fewer respondents (39%) are inclined to say that science should be at the service of society. The remaining respondents take a neutral position here.

These "positionings" depend to an extent that should not be underestimated on the respective research subject. In particular, scientists who work more theoretically are in favor of the autonomy of science, along with those who are more dependent on technical infrastructures. Humanities scholars are also in favor of greater autonomy, while engineering scholars are less reluctant to put science at the service of society. In addition, professors are more in favor of maintaining a high degree of autonomy, while postdocs and predocs are less reluctant to put science at the service of society.

Inventory of knowledge transfer

When determining knowledge transfer potential, 88% of respondents considered their own research to be "fairly" or even "very relevant" for at least one of the non-academic areas surveyed. Of the remaining 12 %, only 29 people (2.6 %) stated that their research was "not at all relevant" for all of the areas surveyed, while the remaining proportion rated their own research as at least "barely relevant" in at least one area. Overall, the areas of "practitioners" (e.g. medical professionals, technicians, teachers), "politics" and "citizens" are most frequently mentioned as areas for which their own research is relevant.

The significance of knowledge transfer in research practice and the transfer potential must be considered against the background of a diverse research landscape with subject-specific research practices. Thus, the potential for knowledge transfer can vary greatly depending on the specific object of knowledge. The possible audience of knowledge transfer processes also varies depending on the subject matter. Accordingly, very different transfer profiles and potentials emerge for different subject groups. For example, the transfer profile of the humanities and social sciences is more strongly geared towards civil society and politics, that of the life sciences more towards practitioners (e.g. in medical clinics) and that of engineers most strongly towards companies from industry.

The determination of transfer potential in the form of relevance assessments served as the basis for measuring actual transfer practice. It is worth noting that the transfer potential has already been exploited to a large extent. Of all respondents, 73% are in contact with at least one non-academic social group; 55% are even in contact with two or more groups. Only 27% of respondents are not in contact with any of these groups at all.

Exchange within the relevant reference group is most widespread among practitioners. Over 78% of respondents state that they are in contact if they consider their own research to be "fairly" or "very relevant" for this group of people. Well over half of respondents who consider their research to be relevant for the media are also in contact with them (58%). The proportion is even higher for arts & culture (64%), business (66%) and civil society (68%). Only in the reference groups of politics (47%) and citizens (46%) is the proportion of those who consider their own research to be relevant here significantly lower. At the same time, the relevance of their own research is frequently acknowledged, especially for the areas of politics and citizens.

The exchange with social groups follows similar patterns in almost all cases. Interaction before the research process takes place much less frequently than during and after the research process. The media sector has a special position, as interaction as one-sided scientific communication only dominates in the media sector with just under 83%. In contrast, interaction with all other areas mainly takes place during the research process. It can therefore be concluded that, on the one hand, exchange does not take place everywhere where research is considered relevant, meaning that there is still untapped transfer potential. However, it is also far from being possible to speak of so-called "research in an ivory tower": exchange with relevant non-academic interest groups is quite widespread, with 73% of the transfer potential being exploited.

If, from the perspective of higher education or science policy, knowledge transfer activities to society are to be expanded or intensified, the various disciplines and research contexts with their respective knowledge transfer potential must be considered. We suggest starting with the relevance assessments of scientists and differentiating between the various social target groups. Such relevance assessments form a suitable starting point for developing *appropriate* activities in a targeted manner, considering the expertise of the scientists.

It must also be considered that knowledge transfer is initially an organizational goal. The organizations themselves decide whether, how and under what conditions they pass this goal on to the individual departments and working groups or individual scientists, or whether they pre-structure at an upstream level and specifically separate the research contexts suitable for knowledge transfer from the less suitable ones. In this way, very effective (and visible) transfer policies could be implemented with individual, particularly targeted projects and research results (keyword: beacons of knowledge transfer). This would also minimize the pressure for those whose research results are less suitable for direct knowledge transfer and who feel unnecessarily pressured.

In this context, it is also worth mentioning that a fairly large proportion of scientists classify the social utility of research results as an important goal within science, and are therefore motivated to contribute to a third mission. However, it is also precisely those who would like to see the organizations take on a supporting role here.

Conversely, in our opinion, it would not be very expedient to expect all academics to engage in certain knowledge transfer activities in the same way and thus transfer the universities' third mission as a requirement to all individuals equally, e.g. as quantified evaluation criteria. Such measures carry the risk of impairing research practices and content.

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Tables and Figures