Robert K. Merton Zentrum für Wissenschaftsforschung

Berlin Science Survey

Open Science

Research Practices in the Berlin Research Area

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

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Summary

This report presents in detail the results of the first pilot study of the *Berlin Science Survey* (BSS) on the topic of open science. The term open science covers various scientific practices that aim to improve the accessibility, traceability and reusability of scientific results. The *BSS* specifically addressed open access publications, data sharing, code and material sharing, open peer review, and citizen science. In addition to the prevalence of the individual open science practices, attitudes and assessments of the scientists were also surveyed, providing information on the extent to which the science policy goal of expanding open science is shared among scientists. The central results are:

1. Scientists broadly accept the expansion of open science, with the majority of scientists in the Berlin research area expressing positive attitudes towards open science and considering its expansion to be important for science.
2. The majority of them expect an expansion of open science to have positive effects for science in general. However, about one third of the respondents also see risks and dangers. The higher status groups, especially professors, and of the various subject groups especially humanities scientists tend to be more skeptical about the effects of open science.
3. The spread of open science varies between subject groups and for each of the five addressed practices. Open access publishing is the most widespread practice. Scientists report that between 46% (in the humanities) and 64% (in the natural sciences) of their publications are publicly and freely accessible. In general, there is a positive correlation between practicing open science and having positive attitudes towards open science.
4. Quite a few respondents see hurdles in the implementation of individual open science practices. A quarter of the respondents see great or very great difficulties in implementing open access publishing, and just under half see difficulties with data sharing. These assessments vary according to status, but above all according to which research field a scientist belongs to. Two-fifths of the respondents would like to see more support for the implementation of open science from their institution.

From the findings of the report, the following recommendations for action can be derived:

Open science is an umbrella term for several practices that have different implementation possibilities in different research contexts. This means that any of the individual practices cannot be implemented by all scientists to the same extent and in the same way. So far, open science has been promoted mainly on a broad scale, but it should be more targeted, as not all scientists benefit from the same support and incentive structures. Research context and the associated research fields should be considered when implementing control policies and support concepts. The identification of specific hurdles and implementation difficulties in the concrete research situations of scientists is the prerequisite for targeted measures for promoting open science, building on the participation of researchers. This requires not only quantitative cross-sectional data, but also more in-depth qualitative analyses.

1. Introduction

Open science is a collective term for various efforts aimed at improving the accessibility, comprehensibility and reusability of scientific results in the broadest sense, not only targeted to the scientific community, but also to a broader, non-scientific public (Lasser et al. 2022).

Open science is currently broadly being pushed as a science policy goal that is expected to lead to improvements in science and in the relationship between science and society. For example, the European Commission has integrated an open science policy into its Horizon Europe program (European Union 2021), and in Germany, DFG funding programs support open access publications (DFG-Ausschuss für Wissenschaftliche Bibliotheken und Informationssysteme 2022; Deutsche Forschungsgemeinschaft 2020). For the Berlin research area specifically, the Berlin Senate has formulated the goal of creating open access to digital knowledge resources for all (Senat von Berlin 2015). The Berlin University Alliance (BUA) has also put the expansion of open science on its own agenda, and a strategy for open science is being developed at BUA as part of the OpenX initiative (Berlin University Alliance 2023).

The *Berlin Science Survey* project investigates the change of research culture and research practices in the Berlin research area from the perspective of science studies. It thus also serves as accompanying research for the BUA measures and attempts to make intended and unintended effects of political control visible.

The basic evaluation of the *Berlin Science Survey* has already shown that open science is highly valued by scientists in the Berlin research area, but that its prioritization in everyday scientific practice lags behind somewhat (Lüdtke and Ambrasat 2022a, and Fig. 15 below).

For the focus report on open science, the following in-depth questions can be asked:

How widespread are the individual open science practices already in the Berlin research area? What differences can be identified in the degree of their implementation? How do researchers themselves assess the expansion of open science? What hopes and fears are attached to this topic? Finally, what problems and difficulties hamper the implementation of open science and do scientists need support for the implementation?

This report answers precisely these questions using data from the *Berlin Science Survey* (Lüdtke and Ambrasat 2022b). For this purpose, 1,098 questionnaires from scientists and scholars from the Berlin research area, who were surveyed in the winter semester 2021/22, were evaluated. The focus of the evaluation is on the practices, attitudes and discourses on the topic of open science.

For all sub-topics, the differences between the status groups on the one hand and the subject groups on the other hand are illuminated and interpreted in particular. These two important structural variables are intended to tap the diversity of the scientific community. The hierarchical division of status positions into professors, postdocs and predocs not only determines the employment relationship and the career position, but to a large extent, the position is also associated with a specific portfolio of tasks and the role in research and teaching. Furthermore, it is an indicator for the scientific experience and the resources of a researcher, such as time, money and power.

The second central structural variable is the classification by subject groups. The analyses here were differentiated according to the following fields: humanities, social sciences, life sciences, natural sciences and engineering sciences. The field affiliation shapes the researchers through routine work processes, institutional conditions and, not least, through a subject-specific understanding of science and scientificity. However, even within a research field there are sometimes very large differences in concrete working and research conditions, which means that differences between field groups only provide (initial) indications of the diversity of research contexts.

The introduction, implementation and reflection of open science practices thus occurs in a diverse research environment. This report attempts to account for this diversity, focusing on the perspectives of researchers.

2. Dissemination of Open Science Practices in the Berlin Research Area

The term open science does not describe a specific action or practice, but is rather an umbrella term for various practices. The *Berlin Science Survey* took a closer look at the five best-known open science practices: Open access publishing, data sharing, code and material sharing, open peer review and citizen science.

Open access refers to free and open access to scientific publications on the Internet. This means that these publications can be read by other scientists and a broader public who do not have access to licensed publications subject to a fee.

Data sharing similarly refers to the public and free provision of data. Code and material sharing refers to the public and free provision of codes and study-relevant material (questionnaires, blueprints, etc.) used in previous research. Data, code and material sharing only count as open science if both characteristics are fulfilled. If, for example, data is only shared at the discretion and request of colleagues, or if questionnaires, code and material are only available in return for license fees, then these practices do not count as open science.

Less well known is open peer review, which refers to various scientific review procedures in which the review process is made more transparent and comprehensible, e.g., by dispensing with the double-blind procedure or even by making the reviews public so that they can be seen and discussed by the research community. crefers to the involvement of non-scientific, civil society actors in the scientific research process. This can be done for different purposes and at different stages of the research process.

In order to determine the current degree of dissemination of open science in the Berlin research area, the scientists were asked to what extent they implement these various open science practices in their everyday research.

2.1 Open Access Publishing

The scientists participating in the *BSS* state that on average about 55% of all their publications are freely available on the Internet (see Figure 1). This result is lower than the 63.3% reported by the Berlin Open Access Office for the Berlin research area in 2020 (Kindling et al. 2022). However, the latter value refers only to journal articles, whereas the self-assessment in the *BSS* refers to all forms of publication, i.e., also monographs and anthology entries without time restrictions. According to this self-assessment, 17% of respondents state that they publish exclusively in open access, while 9.6% have never published in open access (both not shown).

The breakdown by status group shows that there are no differences between postdocs and predocs (see Figure 1). Both status groups have published a good 56% of their publications in open access format, with the open access shares of professors falling slightly behind at 52.2%. This difference can be interpreted as a cohort effect: the older cohorts also have older publications, which were generally published less frequently in open access formats. Overall, there are no substantial differences in open access publishing behavior between the status groups.

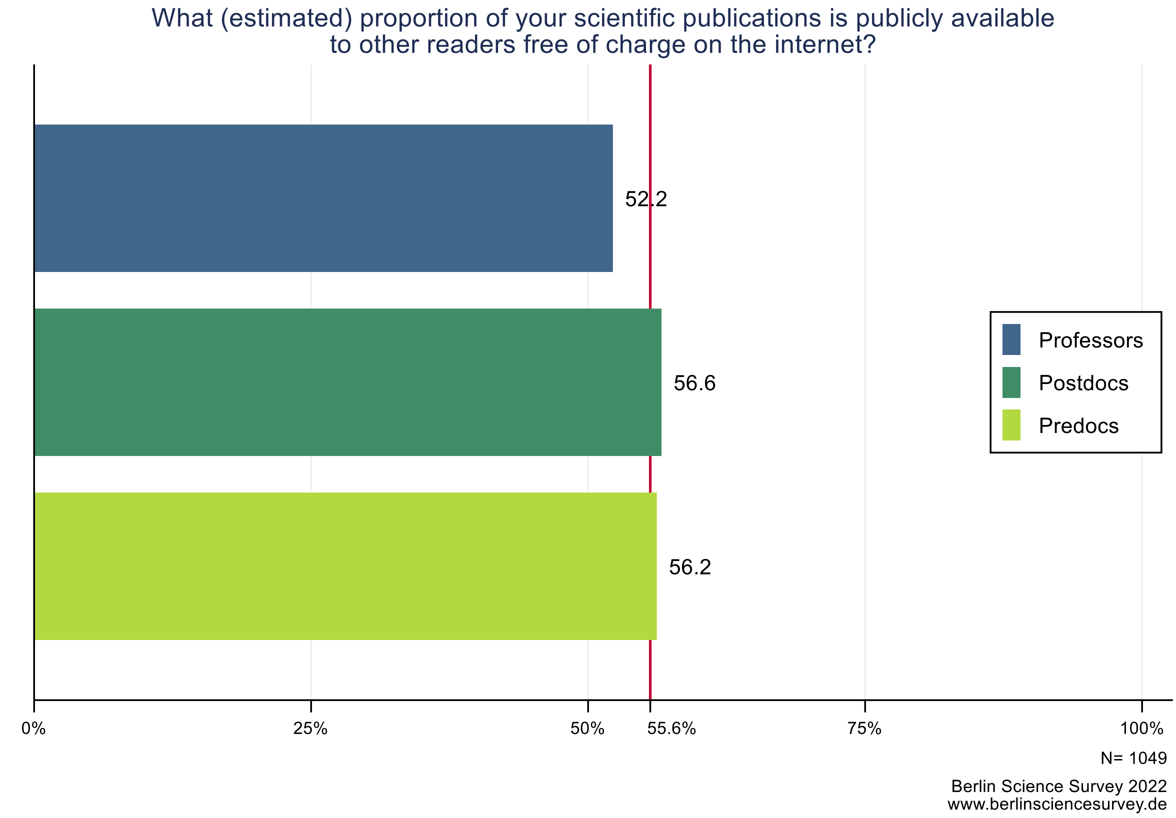

Figure 1 Share of open access publications, by status group

However, there are clear differences between the subject groups regarding open access publishing. Figure 2 shows that open access is least widespread in the humanities, but even there, 46% of publications are freely accessible. The pioneers in open access publishing are the natural sciences, with an average share of freely accessible publications of 64%. This is not surprising, as the natural sciences already have a long tradition of relevant infrastructures in the form of open science repositories, such as arXiv. In addition, the natural sciences are dominated by an article-based publishing culture that is generally already better adapted to the requirements of open access publishing (Grimme et al. 2019). In contrast, especially in the humanities, monographs and edited volumes are still widespread (Schneijderberg et al. 2022), which are less often made openly accessible than journal articles (Grimme et al. 2019). Differences in open access publishing can thus be attributed, at least in part, to subject-specific publishing cultures.

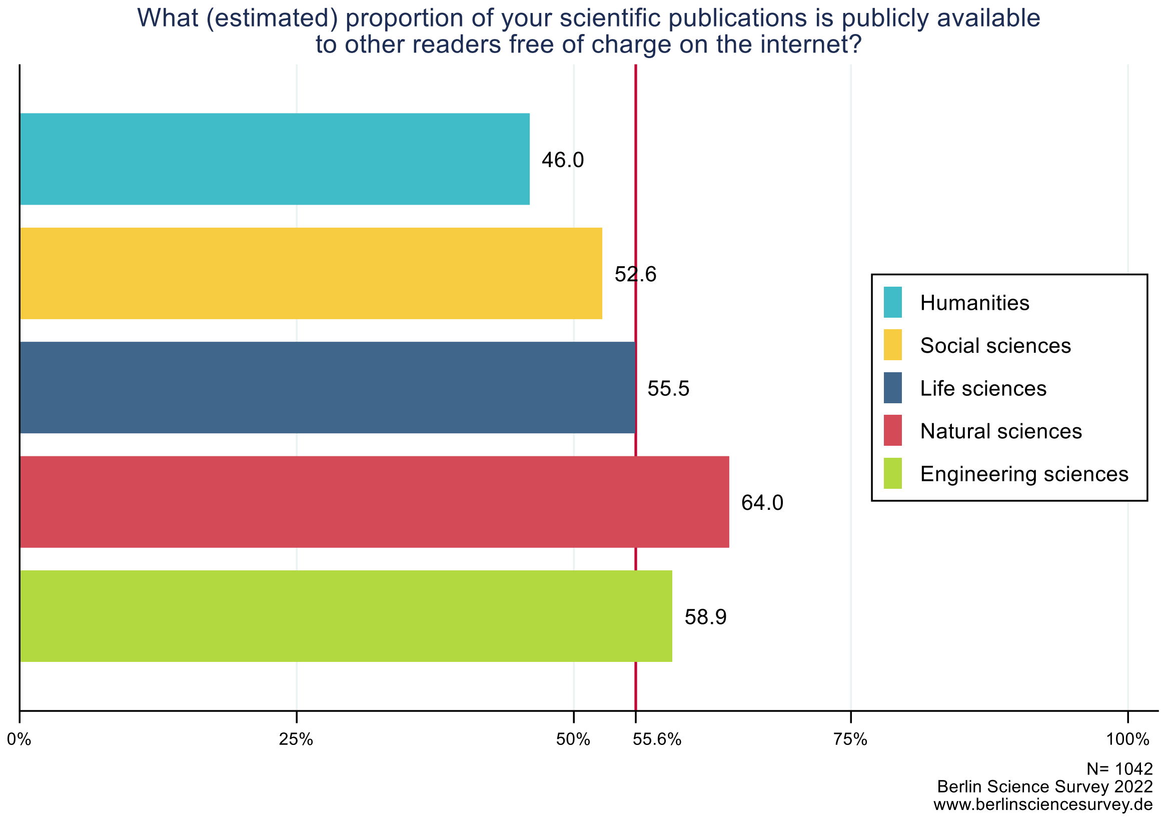

Figure 2 Share of open access publications, by subject group

There are various options or open access routes for making scientific publications available to the public free of charge.

Gold Open Access includes all electronic first publications in freely accessible journals (open access journals). Green Open Access includes all electronic second publications (as pre- or post-prints) in freely accessible institutional or specialist online archives or repositories or on the author's own website. In hybrid open access, individual articles in journals that are not otherwise freely accessible are "bought" for the readership in return for a fee.

DFG programs to promote open access publications explicitly only cover the fees for open access publications via the golden path and not for secondary publications (DFG-Ausschuss für Wissenschaftliche Bibliotheken und Informations-systeme 2022; Deutsche Forschungsgemeinschaft 2020). This puts many scientists in a quandary, as many important (prestigious) journals often do not have a gold open access business model (Open Access Monitor 2023).

In the *Berlin Science Survey*, those who had previously stated that they publish open access (90.4%) were also asked which of the three most common open access paths they predominantly use to publish. This showed that the golden path of publishing predominates with 51%. The green path of pre- or secondary publication is taken by 39% of respondents, and the hybrid path is also taken by a good third of respondents (not shown).

However, these average values conceal some significant differences between subject groups (see Figure 3). While Green Open Access predominates in the engineering sciences, the golden path is dominant in all other subject groups and especially in the life sciences. The latter, on the other hand, use Green Open Access much less frequently (only just under 25%). The format of Hybrid Open Access is used least frequently by the humanities, at 21.5%. The different distribution of the various open access formats may have discipline-cultural, financial and publication-strategic reasons. Since both the federal government's open access Strategy and the DFG's program to promote open access publications usually only cover the costs of gold open access, the costs of the hybrid format have to be carried by the scientists themselves. However, the proportion of publication costs carried by the scientists themselves varies greatly between subject groups (Over et al. 2005). Life scientists in particular have to contribute to publication costs (ibid.).

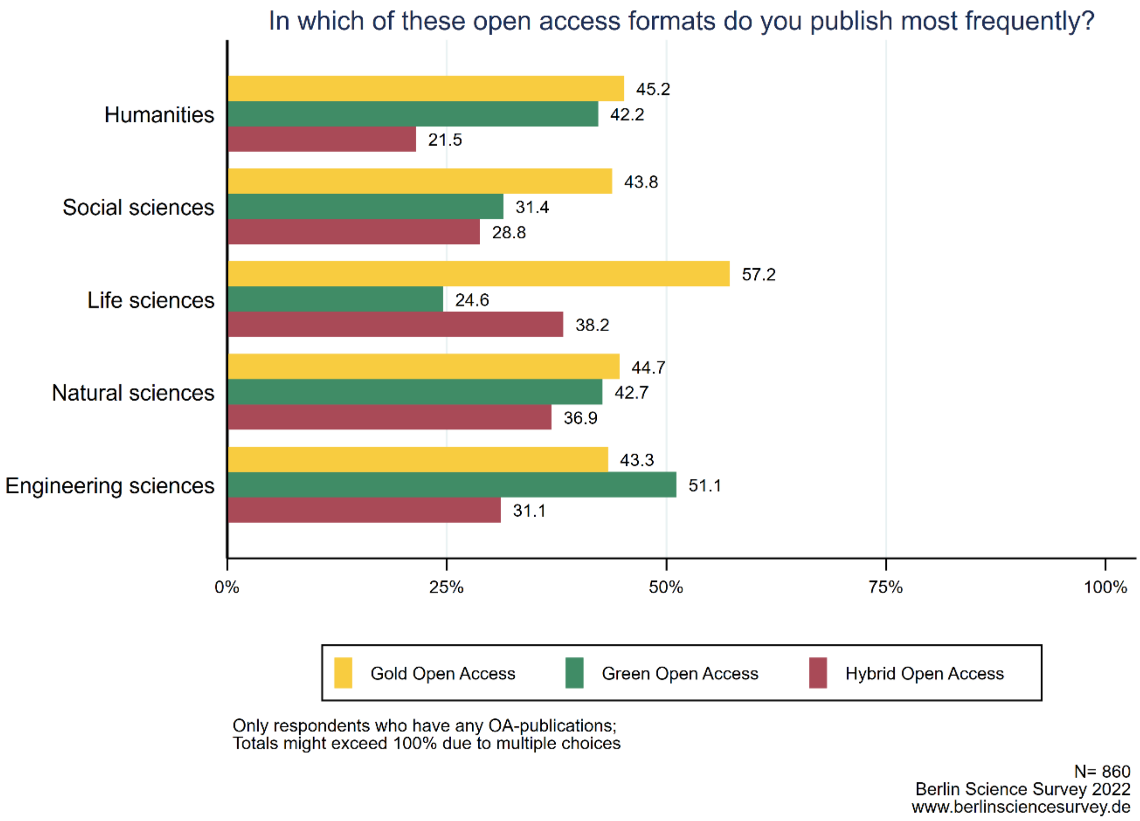

Figure 3 Use of various open access formats, by subject groups

Overall, it is clear that open access publishing is already widespread in the everyday research practices of the vast majority of scientists in all status groups. Nine out of ten scientists have open access publications; only one tenth have not published any at all, and these are predominantly predocs. So far, 17% of all respondents have published exclusively in open access. However, there are still differences between the subject groups in the proportion of publications made publicly and freely accessible and in the format of their publications. While the natural sciences are trailblazers in open access publishing, the life sciences are pioneers in Gold Open Access, which is the path most strongly demanded and promoted by research policy.

2.2 Other Open Science Practices

In addition to open access publishing, the *Berlin Science Survey* also surveyed the prevalence of other open science practices (data sharing, code and material sharing, open peer review, and citizen science), which aim to increase transparency and accessibility. These four practices have been found to be less widespread compared to open access (see Figure 4). On the one hand, this may be because they have not (yet) arrived in certain parts of the scientific community. On the other hand, this may also be because they are not relevant in some research contexts. For example, if no data is collected or produced in the research process, data sharing is not a relevant practice here. This difference was considered in the survey. In fact, 18.2% of respondents in the *BSS* confirm that data sharing has no relevance to them. For code and material sharing, this is 24.2% of respondents. In the case of open peer review, 14.3% state this. And with regard to citizen science, as many as 24.7% state that this practice does not apply to their research practice.

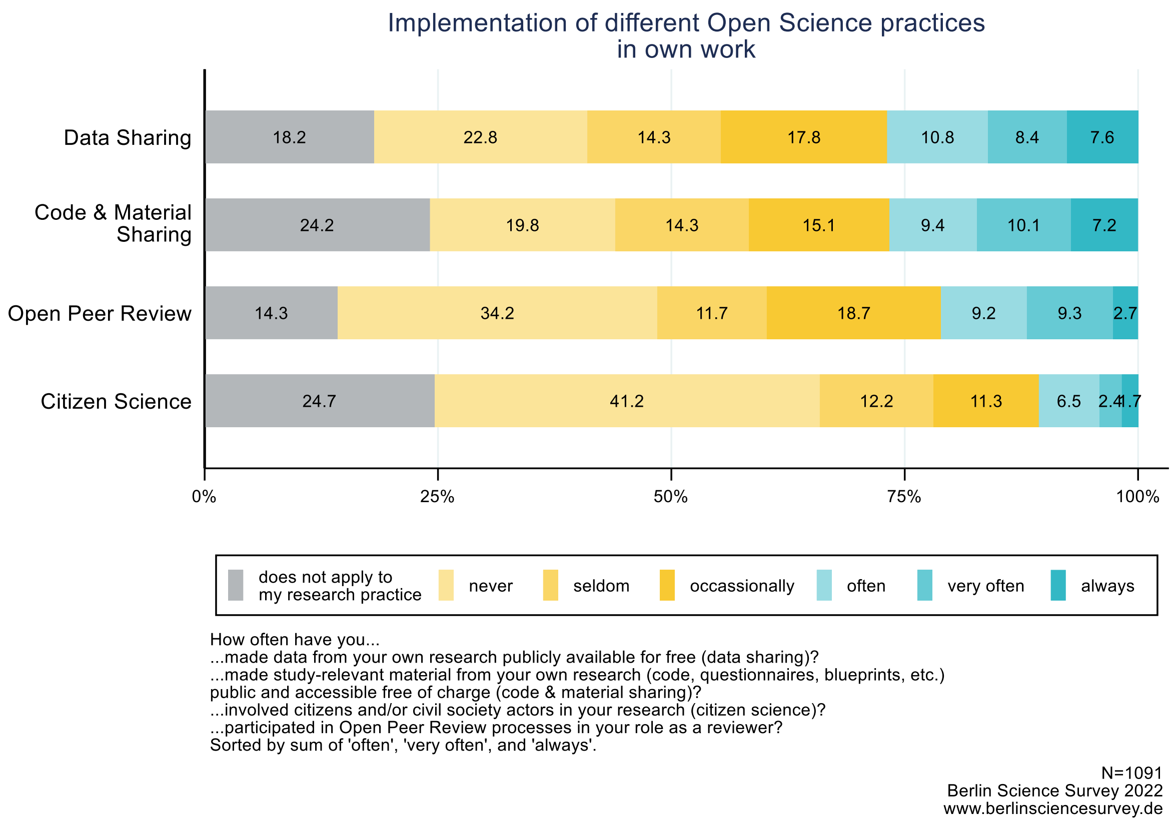

Figure 4 Distribution of different Open Science practices

The respective open science practices can be said to have a certain routine in scientists' research practices when they are carried out regularly, i.e. "often", "very often" or "always". In this sense, data sharing has already become routine for 26.8% of the respondents. Code and material sharing is part of the daily research routine for 26.7% of the scientists surveyed. About one fifth (21.2%) of the respondents regularly participate in open peer review processes. Far behind the other practices is the involvement of non-scientific actors, which is part of everyday research for only 10.6% of the respondents (see Figure 4).

This insight can be further differentiated when status groups and subject groups are compared. The difference in prevalence of open science practices between status groups (see Figure 5) points to the different roles and responsibilities that professors, postdocs and predocs perform in academia. The greatest differences can be seen in the sharing of research data, and especially in the involvement in open peer review processes. In both cases, professors are far ahead of junior researchers. In the case of open peer review, the difference between professors and predocs of around 34 percentage points and between professors and postdocs of almost 18 percentage points is particularly striking (see Figure 5). This is hardly surprising, however, since scientific quality control in review processes in general - i.e., also in blind or closed peer review - tends to be taken over by more established scientists.

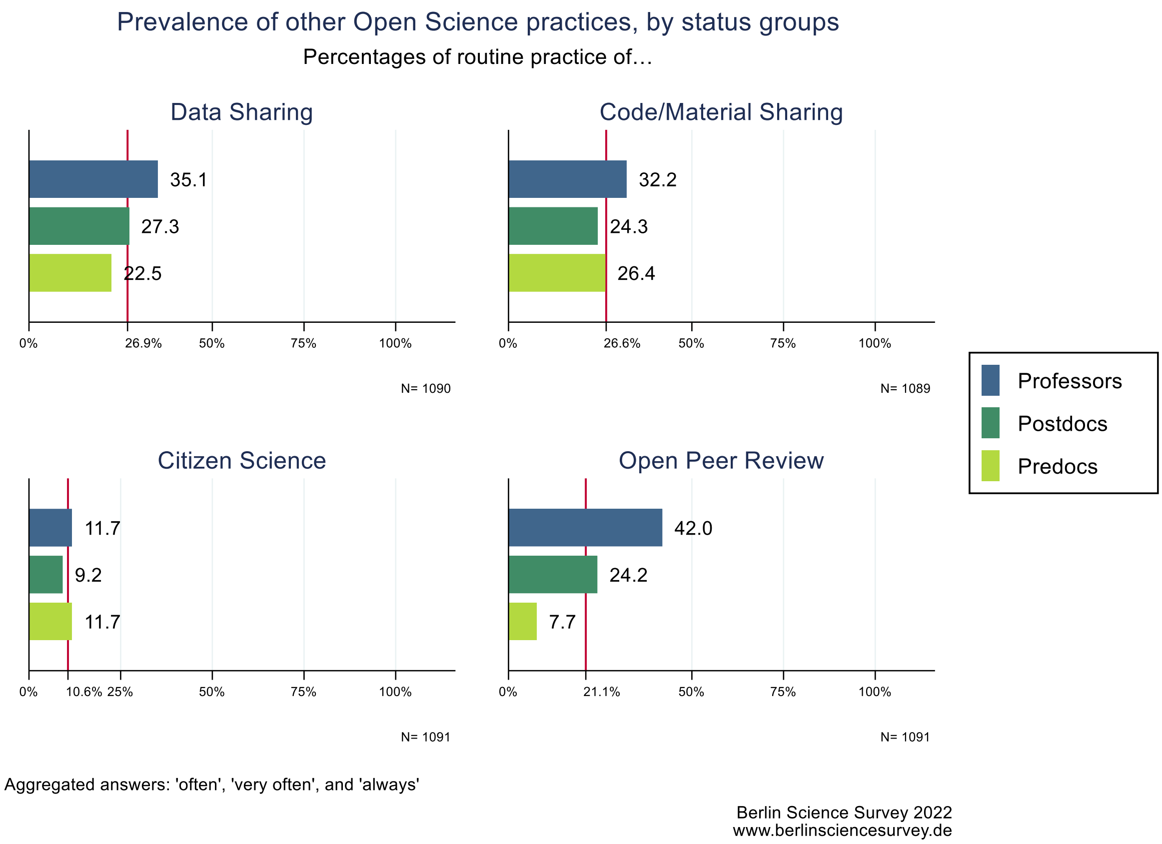

Figure 5 Distribution of different Open Science practices, by status groups

Similarly, the prominent role played by professors in sharing research data may be, among other things, a result of institutionalized and often legally regulated accountability structures for such data and thus for their sharing. For code and material sharing, status group differences are somewhat less pronounced. As many as 26.4% of the predocs surveyed regularly share code or material relevant to their studies. This can be interpreted as an indication that this practice offers a lower-threshold access also for junior scientists. The proportions are also much more balanced when it comes to the regular practice of citizen science. The status group hardly plays a role here. However, more than one third of the predocs surveyed state that citizen science is not relevant to their research, compared to around 16% and 19% for professors and postdocs, respectively.

If we look at the implementation of open science practices by subject groups, we see that the life sciences, natural sciences and engineering sciences, each with a share of regular implementation of around 30%, are well ahead of the humanities and social sciences, which have shares of 20% and 23% respectively (see Figure 6). This indicates that the types of data processed in different research contexts are associated with different difficulties in processing and provision. In particular, the sensitivity of the data collected and the associated data protection constraints sometimes differ greatly between research contexts.

Compared to data sharing, the picture is reversed for citizen science: While only about 6 to 8% of the respondents from the life, engineering and natural sciences stated that they 'often', 'very often' or 'always' collaborate with non-scientific actors in their research, more than 23% of the social scientists and 11.5% of the humanities scholars stated this (see Figure 6).

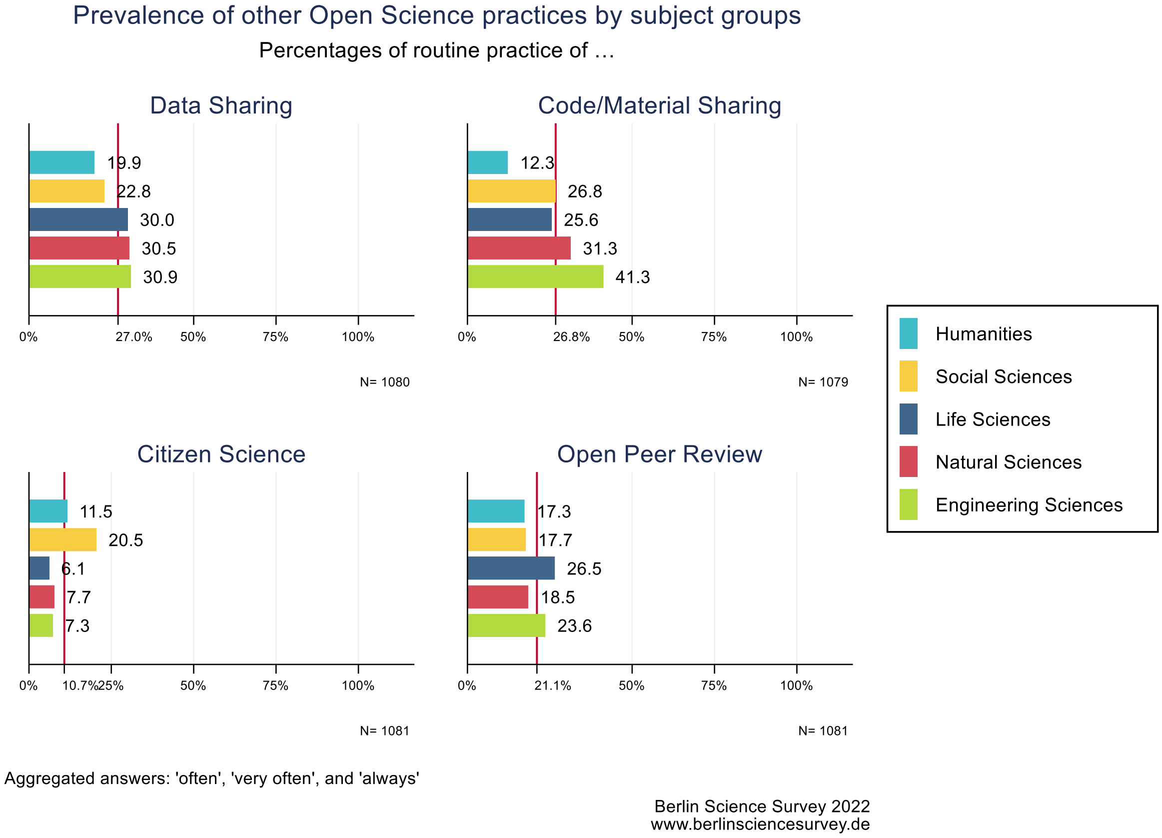

Figure 6 Distribution of different Open Science practices, by subject groups

Sharing research-relevant materials and codes is most common in engineering. For 41.3% of respondents from this discipline, this practice has become routine. In the other subject groups, the degree of prevalence is significantly lower. While the social sciences, life sciences and natural sciences are relatively close together here with 25.6 to 31.3%, only 12.3 % of the humanities researchers regularly share code or material (see Figure 6). This comparatively low value is mainly explained by the fact that more than half of the humanities scientists state that this practice is not relevant in their research context (not shown). If one excludes those in whose research practice code and material sharing is not relevant, there are smaller but still noticeable differences between subject groups (Figure 7).

To date, open peer review has been practiced particularly in the life sciences and engineering (26.5% and 23.6%, respectively). There are hardly any differences between the humanities, social sciences and natural sciences for this practice - in these three subject groups, between 17 and 18% of researchers regularly participate in alternative peer review procedures.

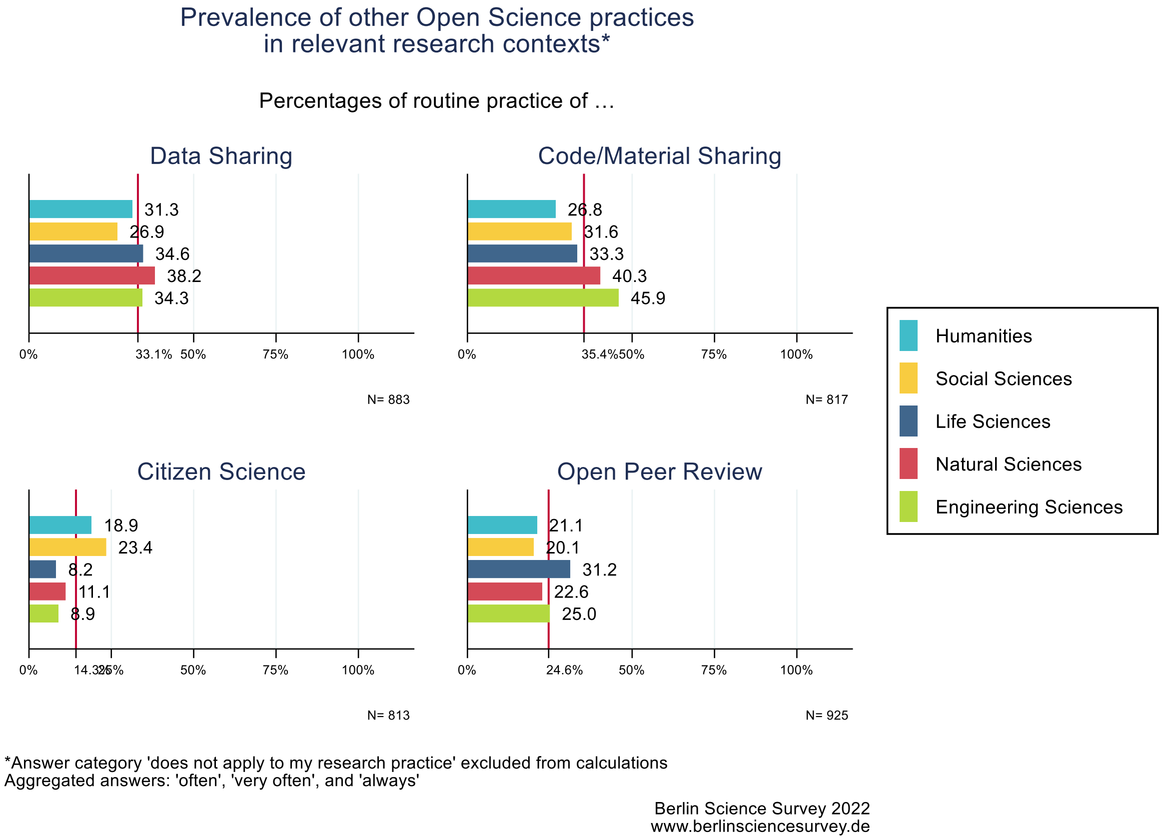

Figure 7 Distribution of different Open Science practices, by subject groups, only with relevant research context

Overall, there are clear discipline-dependent differences in the implementation of the open science practices considered here. This indicates that some research contexts are more suitable for a particular open science practice than others. Consequently, science policy governance should not treat all subject groups in the same way and measure all researchers by the same yardstick. Rather, a differentiated view of the implementation of individual open science practices that does account for the diversity of different research realities is needed.

3. Attitudes and Assessments towards Open Science

Previous surveys on open science among scientists show a clear picture: the vast majority have a positive attitude toward open science (Fecher et al. 2017; Ambrasat and Heger 2020; Tenopir et al. 2020; Christensen et al. 2020). This was also confirmed for the Berlin research area: the basic evaluation of the *Berlin Science Survey* already showed that open science is highly valued by Berlin scientists (Lüdtke and Ambrasat 2022a). Specifially, 78.8% of respondents say open science should be an overriding or even one of the highest goals in science (ibid, p. 4 and adopted here as Figure 8). This goal thus ranks behind the goals of originality and methodological rigor and good teaching, which are intrinsic to research, but well ahead of the goals of interdisciplinarity and social usability of research results, which are more externally applied to science.

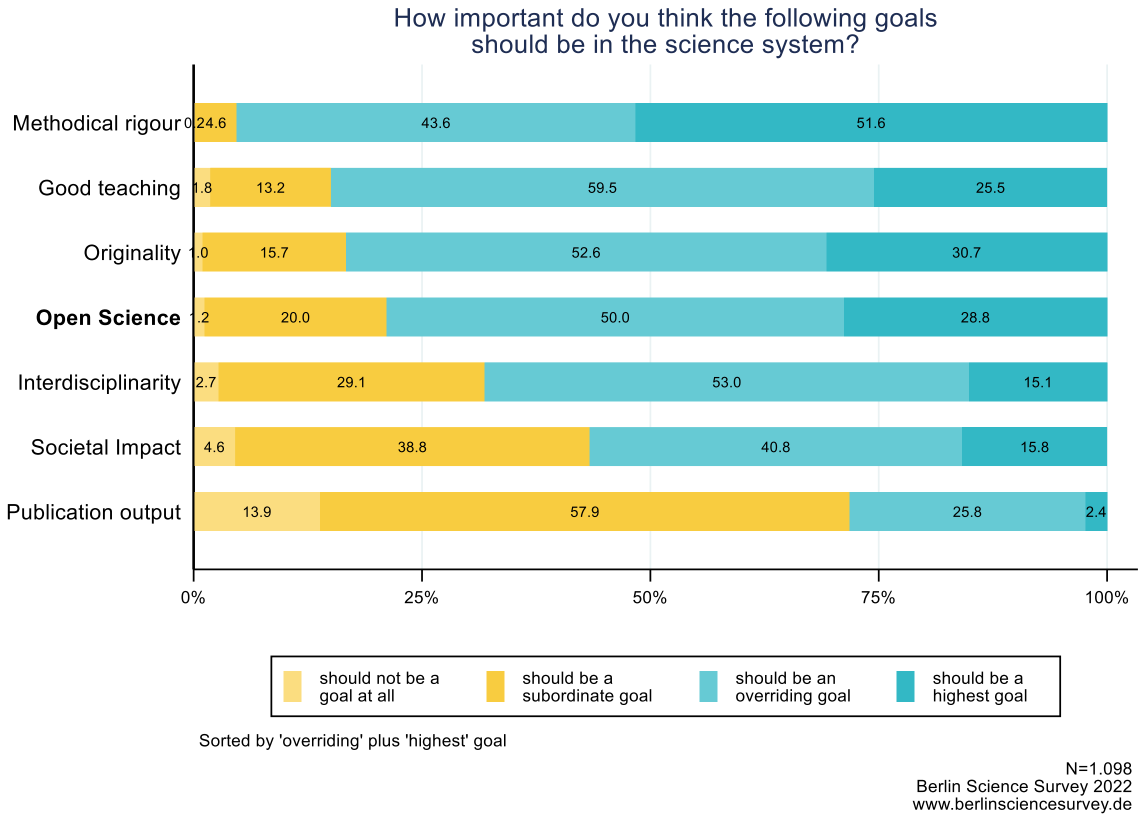

Figure 8 Importance of different goals in the science system - normative assessments of the respondents

The *Berlin Science Survey* also differentiated various aspects of attitudes toward open science. In addition to the general assessment of the importance of open science, the individual benefits for the scientists were surveyed, as well as assessments of the possible effects of open science on the science system.

3.1 Assessment of the Importance of Open Science for Science

Over 83% of respondents view the expansion of open science as very important or fairly important to science (see Figure 9).

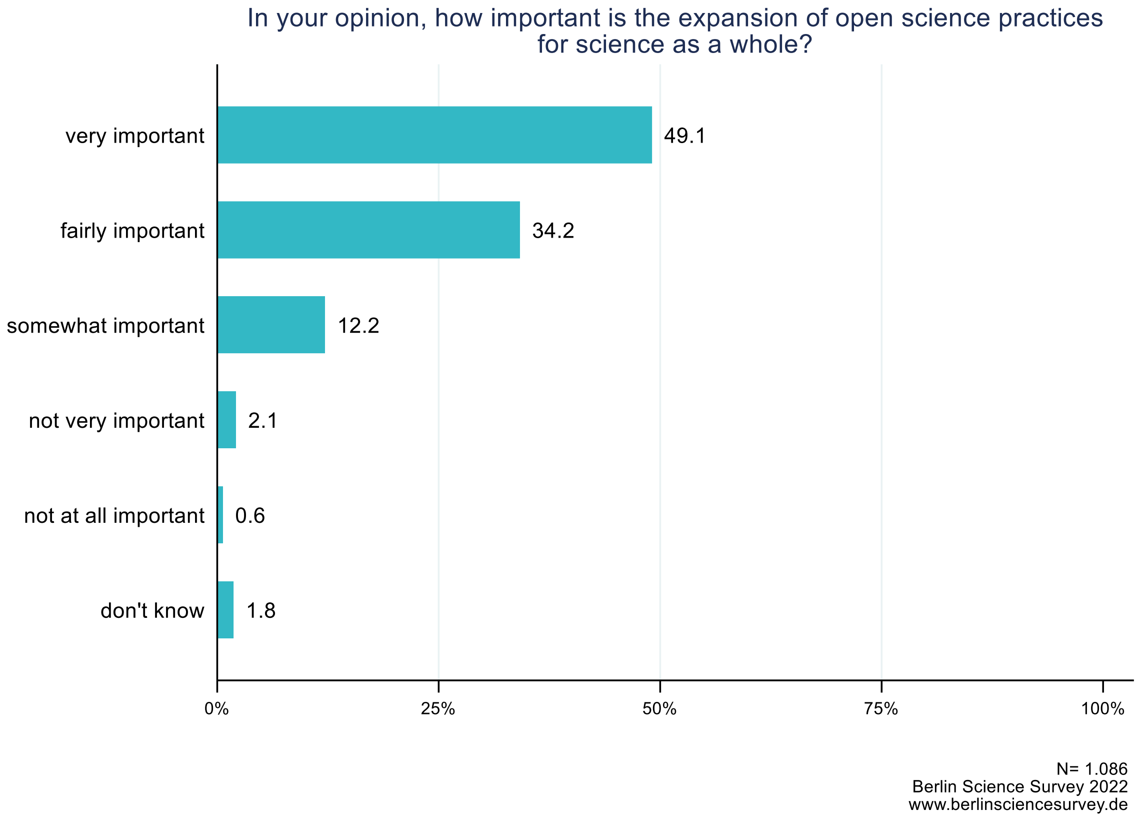

Figure 9 Importance of Open Science for Science

A comparison of the status groups, however, shows that the approval ratings for open science decrease significantly with higher status (see Figure 10). While 91.4 % of junior researchers consider open science to be 'quite' or 'very important', the value drops to 83 % for postdocs and to 75 % for professors, which are nevertheless high approval ratings.

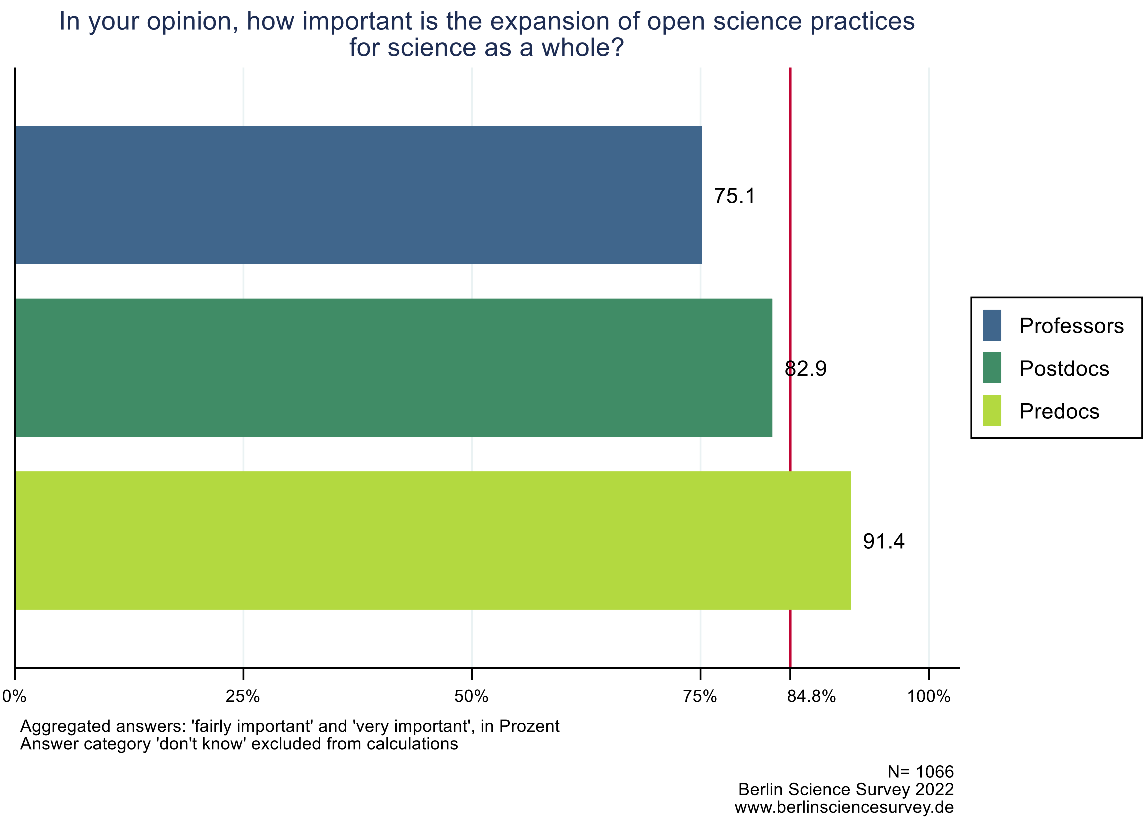

Figure 10 Importance of Open Science for science, by status groups

A comparison of subject groups, on the other hand, reveals almost no differences in the assessment of the importance of open science for science (see Figure 11). In all subject groups, more than four fifths of the scientists find the expansion of open science practices 'fairly important' or even 'very important' for science. The variance in the assessment of importance does not seem to depend on research context or research culture, but plays out more at the level of individual opinion formation, not at the collective level of research contexts.

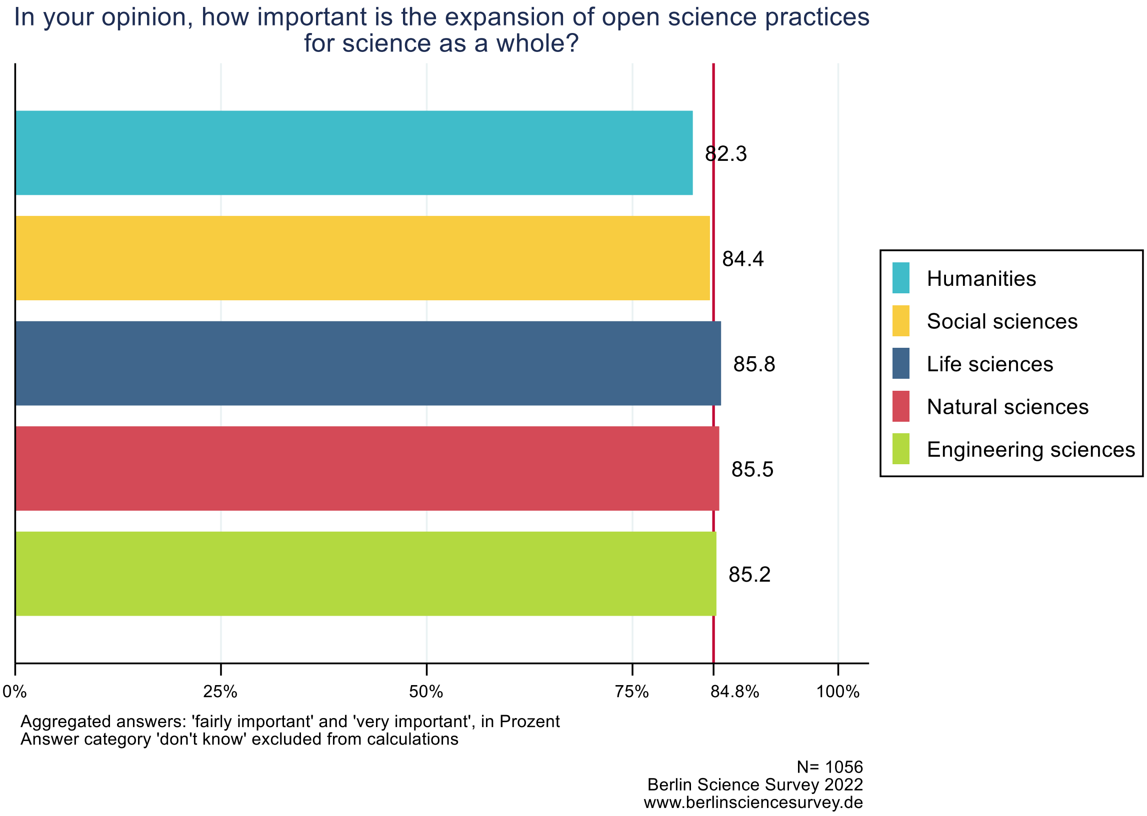

Figure 11 Importance of Open Science for science, by subject groups

3.2 Discourses on Open Science

Individual attitudes and opinions on the importance of open science can also be shaped by public debate and discourse that scientists perceive in different ways or in which they position themselves differently. In order to be able to map discourse positions, various statements were presented to the respondents on which they were asked to take a position. The nine different items represent statements that are heard in the debate about open science either as reasons for or concerns about open science. By having respondents take a position on these statements in the *BSS*, it is possible to capture the positions that scientists (would) take in the debate. In order to keep the questionnaire as short as possible, these statements were only presented to a randomized subsample of 50% of the respondents, while the other half of the respondents were asked more in-depth questions on the topic of collaborations.

The overall assessment clearly shows that a large majority expects positive effects from an expansion of open science, while only a minority of about one third of respondents also sees dangers and voices concerns. For example, 92.4% of respondents agree that open science increases the transparency of research (see Figure 12) and 74.3% agree that open science increases public acceptance of scientific work and reduces global inequality in the science system. About two-thirds of researchers believe that expanding open science will improve the quality of scientific output, and a slight majority believe that open science will increase research productivity (see Figure 12).

The three items describing dangers and risks are each agreed with by about one-third of respondents. 40.6% of respondents believe that an expansion of open science will lead to increased commercialization in science (e.g., through data tracking). 35.5 % fear an increased risk of idea theft and just under 33% expect "intensified competition in the scientific community" (see Figure 12). Although the positive assessments clearly predominate, at least one in three researchers also has concerns and shares expectations about possible dangers.

Overall, the predominantly positive assessments of the effects support the previously presented positive attitudes toward open science.

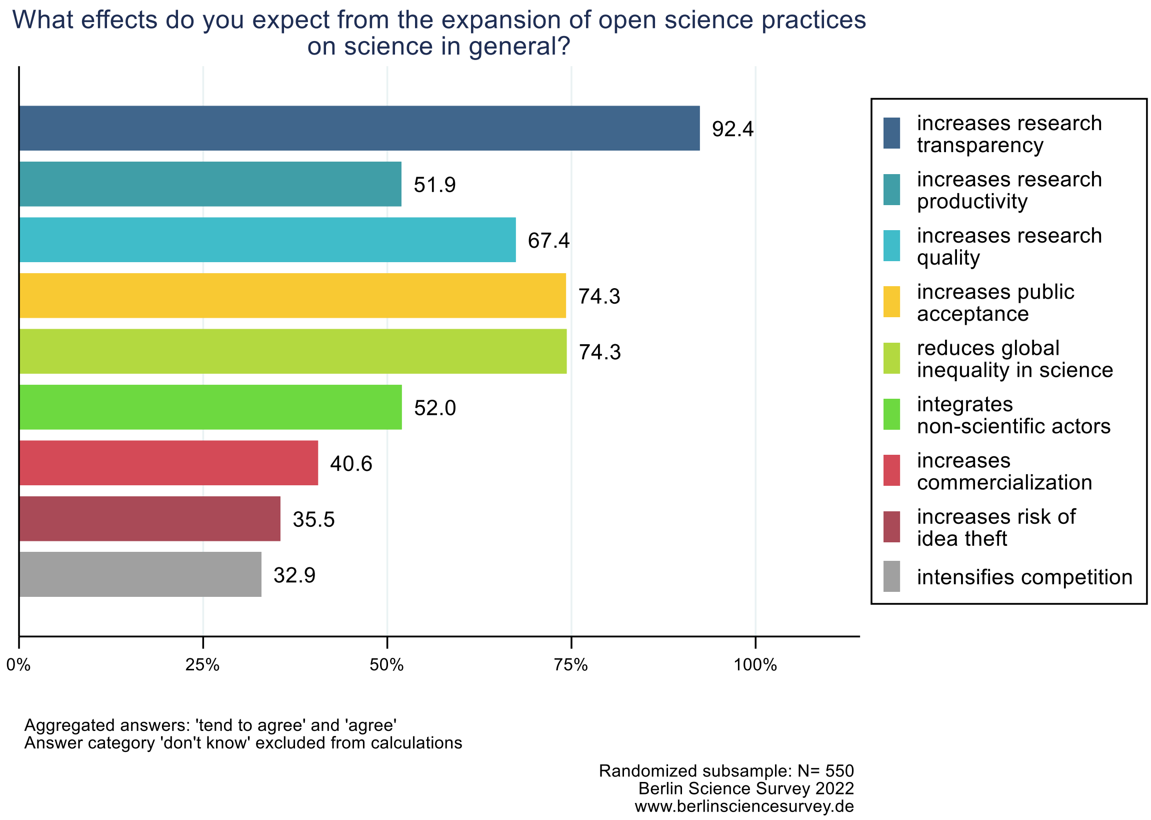

Figure 12 Agreement with statements on possible effects of Open Science

The congruence of discourse positions and attitudes is also reflected in the comparison of status groups. Predocs see the effects of open science significantly more positively than the other groups. Their expectations of an increase in productivity (68%) and improvement in quality (79.4%) are significantly higher than those of the other groups (see Figure 13). On the other hand, predocs expect potential dangers and risks less often. Among the professors, skepticism is more prominent: expectations of productivity gains (37%) and quality (56%) are significantly lower, while concerns are emphasized more strongly. In particular, the majority of professors (59%) expect increased commercialization. The postdocs' opinions are located between those of the predocs and the professors. While the "younger" scientists have a more positive attitude overall, the older scientists, and especially the professors, are clearly more skeptical in their assessment of the opportunities and risks of an expansion of open science.

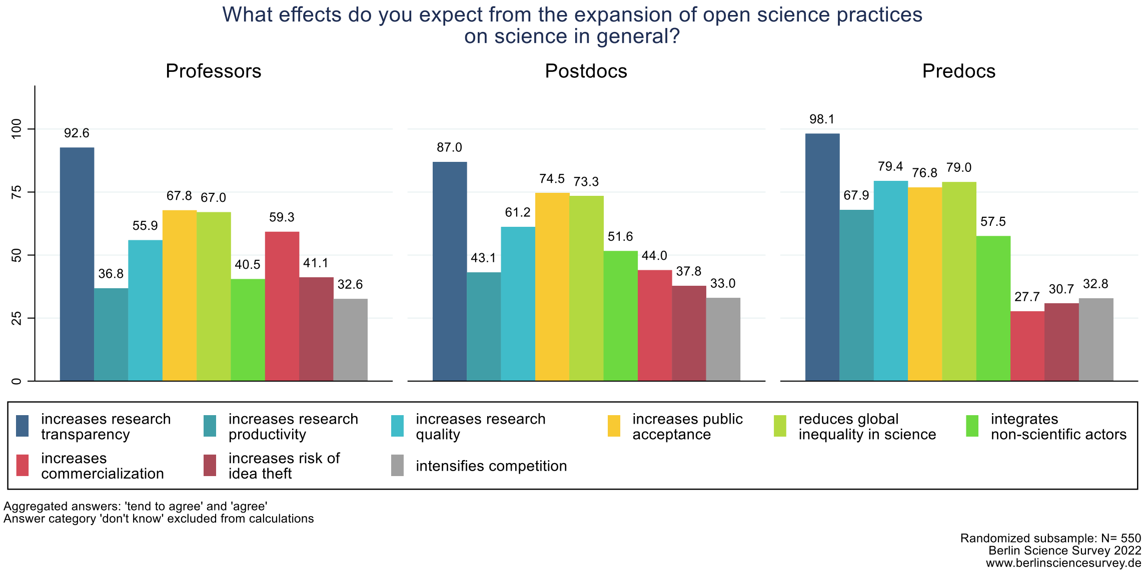

Figure 13 Agreement with statements on possible effects of Open Science, by status groups

A comparison of subject groups also reveals relatively distinct discourse profiles (see Figure 14). There seems to be widespread agreement on the 'social' effects of open science in a broader sense: around three quarters of respondents from all subject groups expect the expansion of open science to reduce global inequality in the science system and to increase public acceptance of scientific research and its results. In contrast, the assessments of the possible positive effects on scientific work itself and the fears regarding negative developments in the course of open science differ between subject groups, in some cases considerably.

Here, the humanities are the most critical. A majority of 56.5% of the respondents from this discipline expect an increased commercialization of science as a result of the expansion of open science, while only 42.6% and 47.5% respectively expect improvements in the productivity and quality of scientific research. In contrast, the engineering sciences are much less concerned: only about a quarter of respondents from this field see serious risks. In contrast, two-thirds of the engineering scientists expect productivity and quality to increase (see Fig. 14).

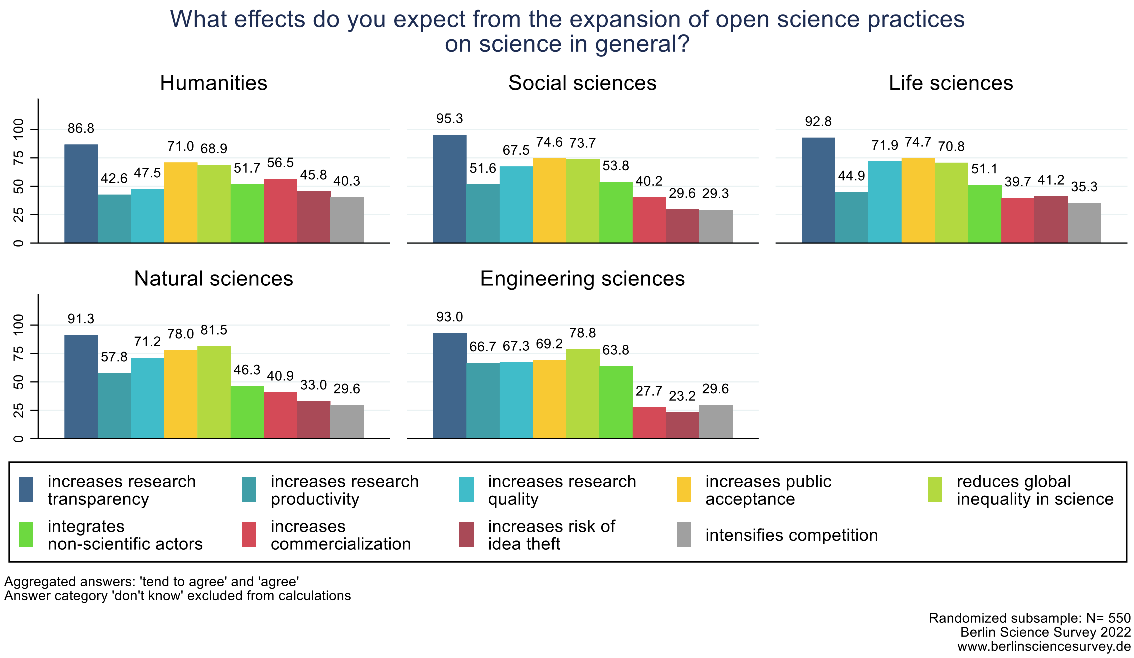

Figure 14 Agreement with statements on possible effects of Open Science, by subject groups

The comparison of subject fields is particularly interesting with regard to the two effects that are expected to directly benefit science - the increase in productivity and improvement in the quality of research. While engineering scientists expect both effects to happen to the same extent, other subject groups show clear differences in the assessment of these two effects. In the life sciences, in particular, there is currently less expectation of productivity gains, but all the more of quality gains. Thus, the life scientists' rather pessimistic assessments of productivity gains are more similar to those of the humanities, while their expectations of quality gains are even more optimistic than those of the engineering sciences.

Such differences between subject groups indicate that the research context is of great importance for the assessment of opportunities and risks of open science. If in a particular context, open science is associated with a significant extra effort on the part of researchers, they may be more likely to doubt that productivity will go up in general, although the opportunity for quality improvement may nonetheless be seen. Conversely, productivity gains would presumably be expected in such research fields where the provision of data is relatively uncomplicated, while the reuse potential is seen as very high.

3.3 Assessment of Personal Benefits from Open Science

The *BSS* asked scientists how important they considered various scientific goals to be, what pressure they felt to fulfill them and how they prioritized the implementation of these goals in their own research practice (Lüdtke and Ambrasat 2022a). The largest gap between the assessment of the importance and the actual prioritization in one's own work is in open science (cf. Figure 15). At the same time, compared to other tasks and goals in science, open science is given lower priority by the scientists surveyed (Lüdtke and Ambrasat 2022a; cf. Figure 15).

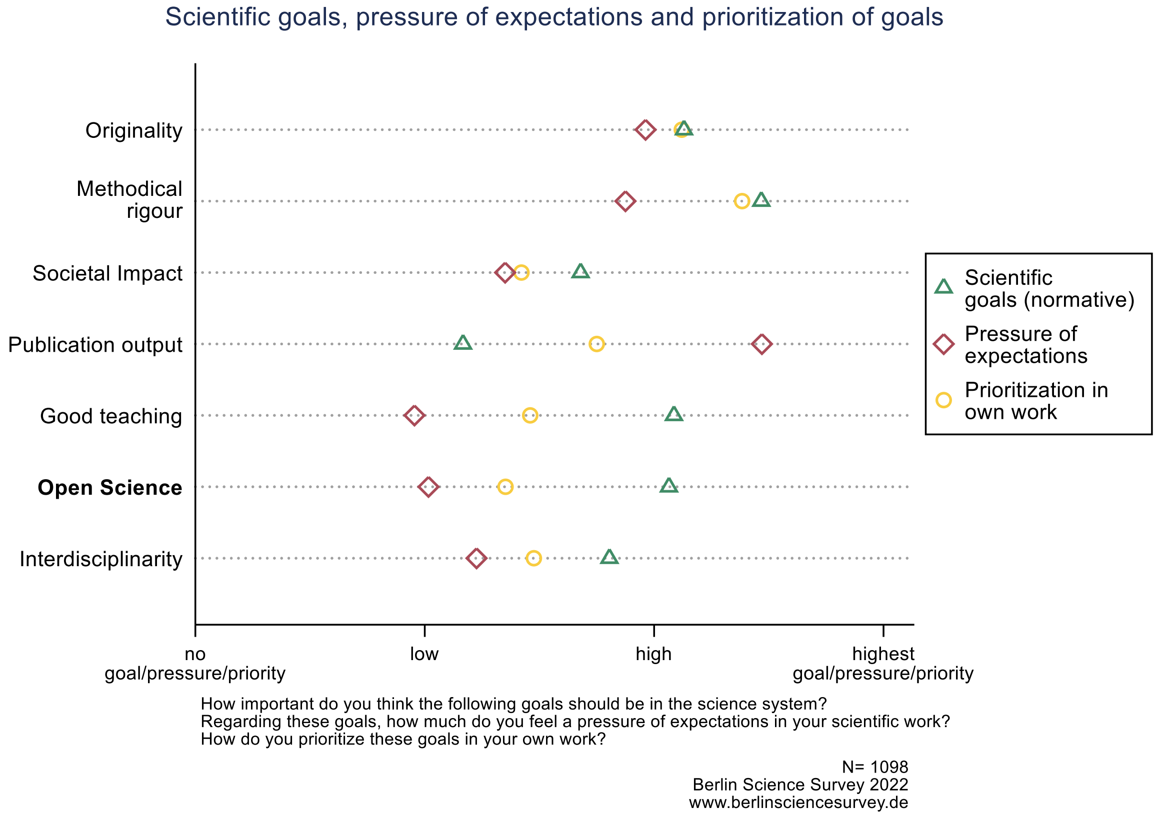

Figure 15 Scientific goals, pressure of expectations and own research practice

One possible explanation for the gap between attitude and practice is the individual benefit that scientists derive from open science. The *BSS* took this into account by asking the respondents to what extent they personally benefit from the expansion of open science (see Figure 16).

The answers here are somewhat more reserved compared to the question about the benefits of open science for the science system as a whole (see Figure 9). While over 83% of respondents rate the expansion of open science as fairly or even very important (see Figure 15), only 40.1% say they personally benefit to a greater extent from open science (responses for "quite a lot" and "a lot"; see Figure 16). A relative majority of 37.2% sees a personal benefit from open science, but this is apparently judged to be rather moderate. Almost a quarter of the scientists state that they benefit “not very much” or “not at all” (see Figure 16).

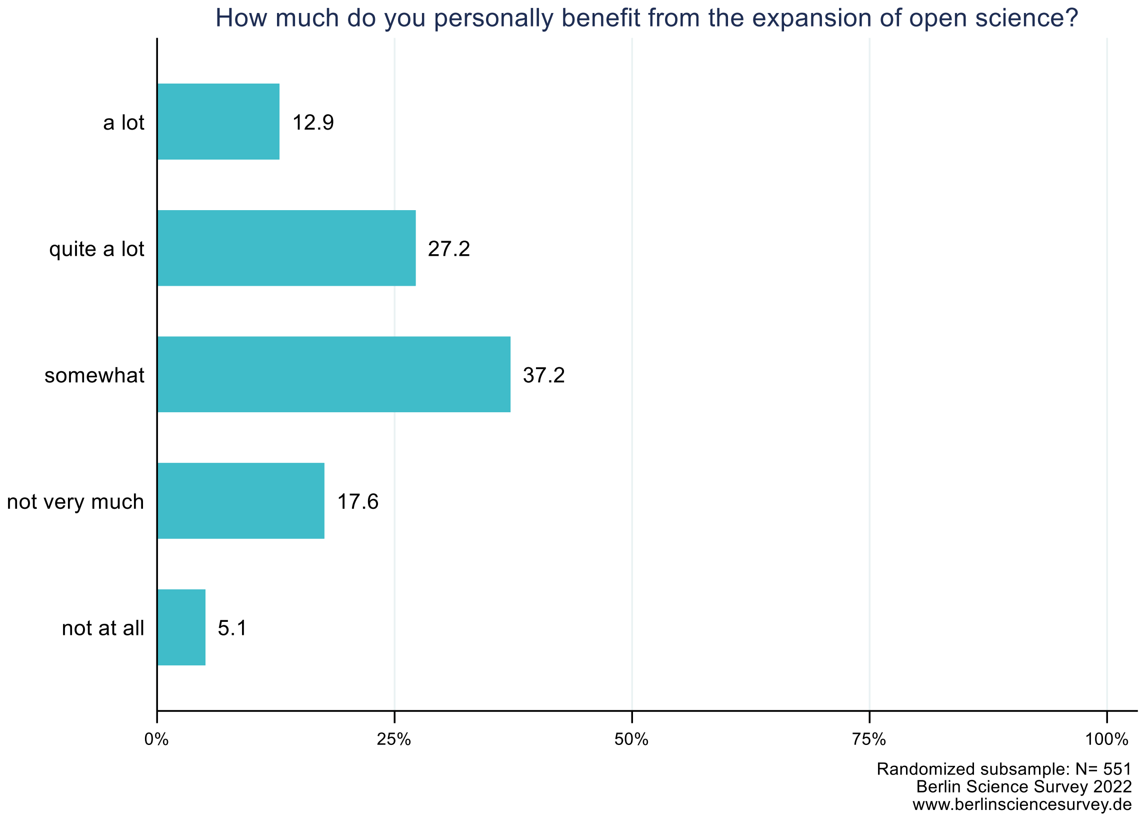

Figure 16 Personal benefit through Open Science

How scientists assess their personal benefit from open science depends strongly on their status and the associated position in the knowledge production process (see Figure 17). Compared to the other status groups, professors are significantly less likely to state that they personally benefit from an expansion of open science. Only about a quarter of respondents in this status group say they benefit "quite a lot" or "a lot". In contrast, almost half of the young scientists surveyed see a personal benefit in the expansion of open science (see Figure 17). The very clear status group differences here point to the various positions in the science system, which are associated with different accessibility to resources. Younger scientists in particular hope that opening up science will improve their research situation.

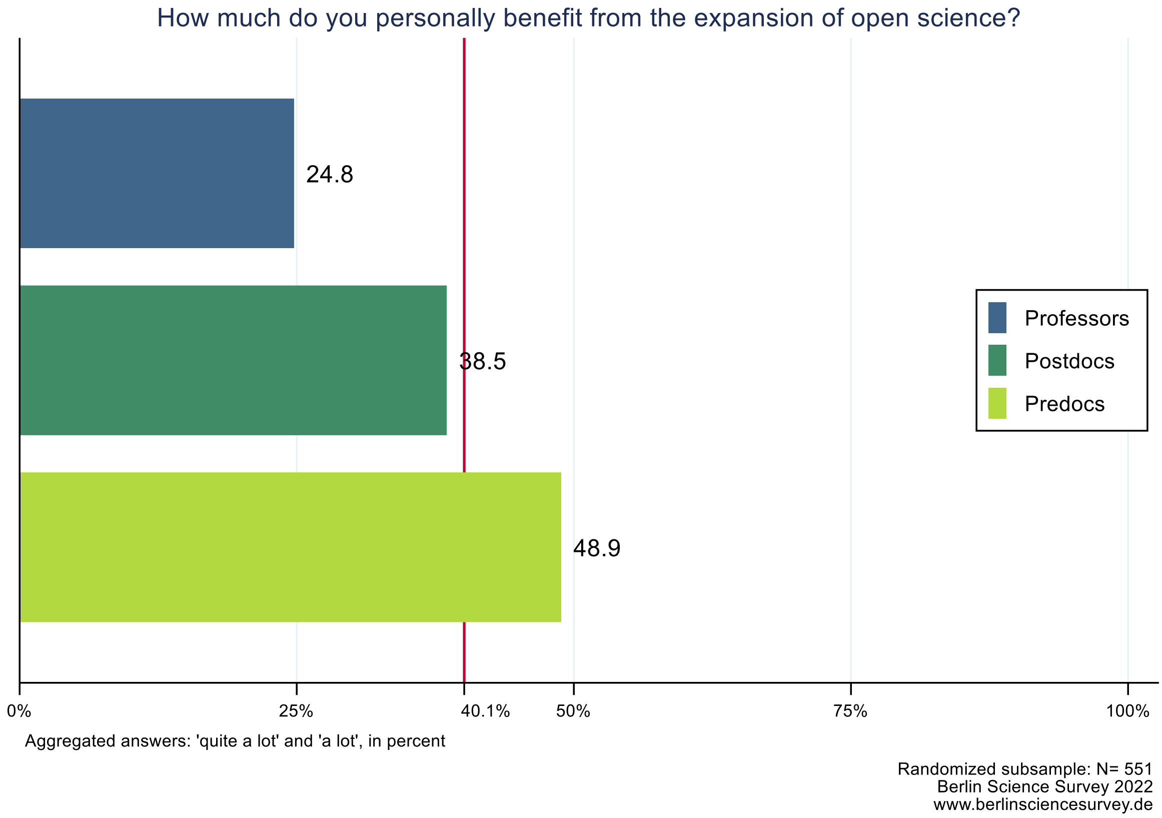

Figure 17 Personal benefit through Open Science, by status groups

There are also clear differences between subject groups with regard to the assessment of their own benefit from the expansion of open science. At 61%, it is primarily engineering scientists who state that they personally benefit from open science. However, natural and humanities scientists also state with above-average frequency that they derive personal benefit from open science (see Figure 18).

This is a very interesting result, especially in light of the fact that there were no discipline-dependent differences in the assessment of the general importance of open science for the science system (see Figure 11). Although all subject groups equally consider open science to be important for science as a whole, the personal benefits of open science are apparently assessed very differently in different research contexts.

These results are consistent with the findings on discourse positions already presented above (cf. Figure 14), which show a very positive assessment, especially of the scientific effects in the narrower sense (increased productivity and quality) of open science in the engineering sciences. The research contexts and conditions in this subject group seem to be particularly suitable for tapping the positive potential of open science and making it usable for the individual scientists.

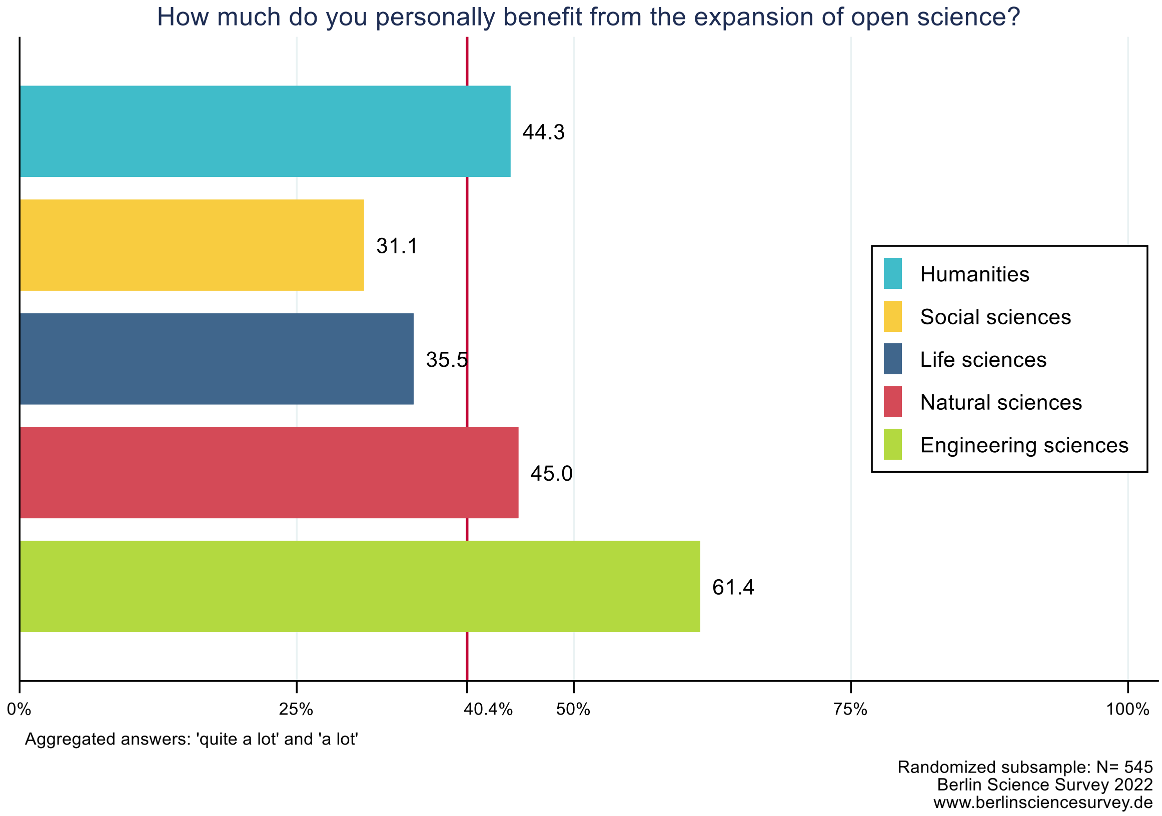

Figure 18 Personal benefit through Open Science, by subject groups

3.4 Relationship between Open Science research practices and attitudes toward Open Science

Now, the question to what extent individuals' attitudes toward open science are related to the extent of their open science practices is a legitimate one. To explore and illustrate this, the statements about the potential impact from expanding open science for each of two groups that are involved in open science practices to different degrees were compared.

Figure 19 shows the comparison of the groups that publish a lot of open access with those that publish little or no open access. Figure 20 compares the group that regularly shares data with the group that shares data irregularly or not at all.

Looking at the differences in expectations between these respective groups, it appears that those who do more open science also have, by and large, more positive attitudes toward open science and expect its potentially negative sides to be less impactful than those who are less involved with open science.

For example, individuals who regularly engage in data sharing are more likely to agree with statements that open science increases the transparency and quality of research and reduces global inequality in science compared to individuals who do not share data at all or rarely share data.

On the other hand, people who regularly share data are also less skeptical about the potential problematic effects of open science. Here, for example, 33% suspect increased commercialization and

27% suspect an increased risk of idea stealing. In the group that does less or no data sharing, the approval ratings for the same statements are 44.6% and 41%, respectively.

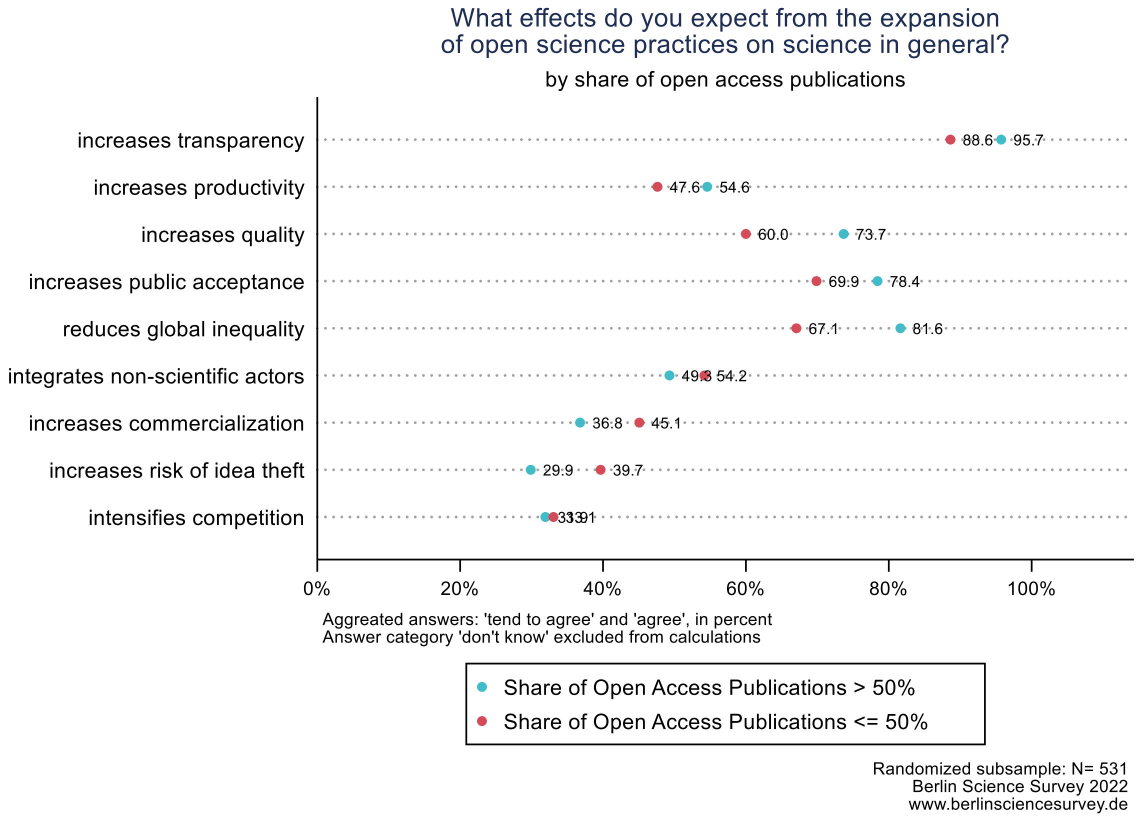

Figure 19 Agreement with statements on Open Science, by Open Access practice

This pattern is also evident in the other attitudes toward open science surveyed in the *Berlin Science Survey* (see Figure 21): The groups that are more involved in open science practices also consider the expansion of open science to be more important for science as a whole than the groups that are less or irregularly involved in open science activities. In addition, the more involved groups also rate their personal benefits from open science as greater.

These bivariate correlations can be interpreted in both directions. On the one hand, it may be assumed that individuals with more positive attitudes are also more likely to turn to open science practices. On the other hand, it is equally reasonable to assume that scientists in principle also affirm the practices in which they are involved anyway or for completely different reasons. We assume that both mechanisms are effective.

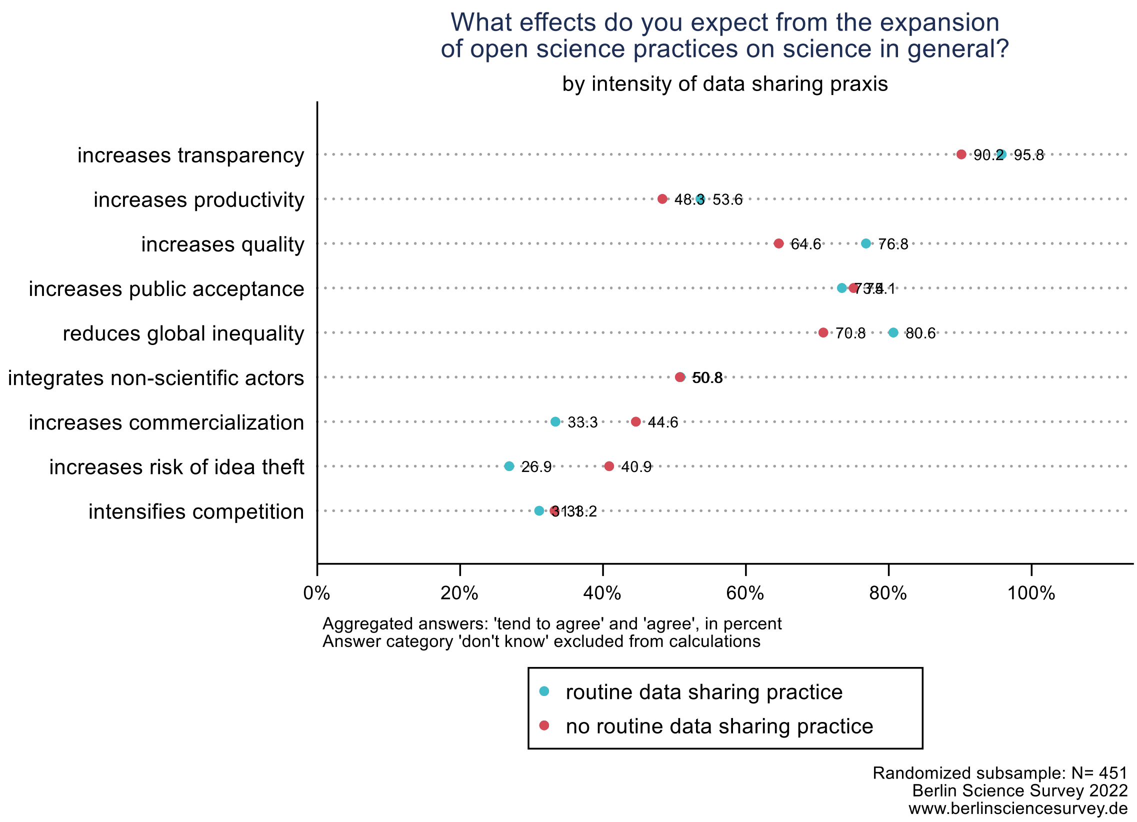

Figure 20 Agreement with statements on Open Science, by data sharing practice

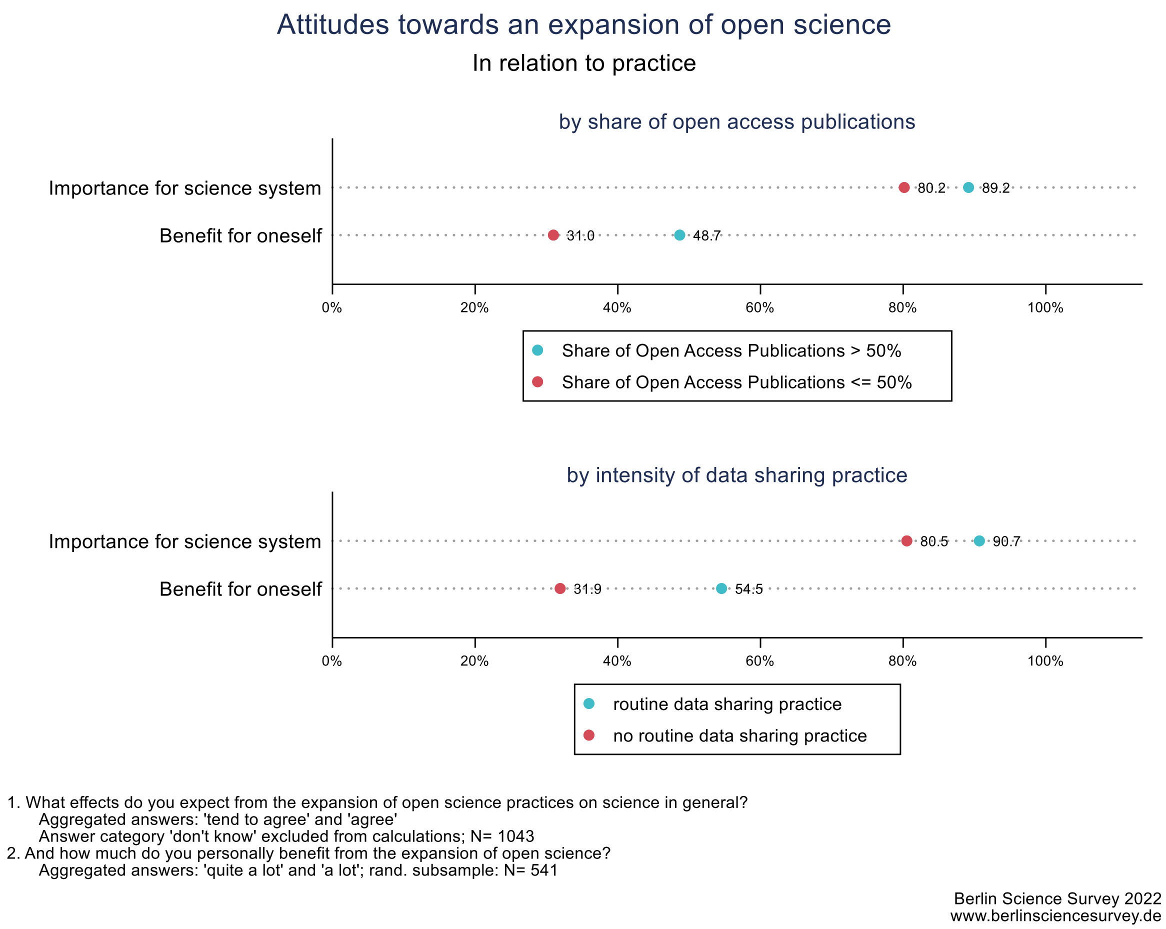

Figure 21 Attitudes toward Open Science by regularity of practicing different Open Science practices

4. Institutional Framework for the Implementation of Open Science

4.1 Difficulties in the Implementation of Open Science

When it comes to the question of where politics and university management can provide support in order to further advance the implementation of open science, it makes sense to examine which scientists see difficulties in the implementation in the first place. Only where difficulties are perceived and a need for support is identified do targeted support measures which are not based on incentives but on cooperation with the researchers concerned have a chance of success. In the *Berlin Science Survey*, researchers were also asked for each individual open science practice whether and to what extent they perceive difficulties in its implementation.

This showed that a comparatively large number of scientists had problems evaluating the difficulties in implementing individual open science practices (see Figure 22). This is especially true for citizen science (41.9%), but also for open peer review (24.4%) and code / material sharing (22%).

Furthermore, even the most established open science practice, open access publishing, still shows hurdles: nearly 25% of respondents say they see great or very great difficulties in implementing OA. This figure exceeds the proportion of respondents who see great or very great difficulties with open peer review (18.9%) (see Figure 22). However, far fewer respondents can assess the difficulties with open peer review (OPR). Looking only at respondents who can provide an estimate, 25% indicate great to very great difficulty for OPR and 26.2% for OA (not shown).

The situation is different for data sharing, where there appear to be the most difficulties. A good 40% of respondents report great or very great difficulties with implementation. If again only those respondents who can give an assessment of the difficulties are considered, the figure is as high as 47.9% (not shown).

A comparison of the status groups reveals surprisingly few differences in the assessment of implementation difficulties (Figure 23). Only in the case of open peer review do the professors see significantly more difficulties and in the case of citizen science somewhat fewer than the other status groups.

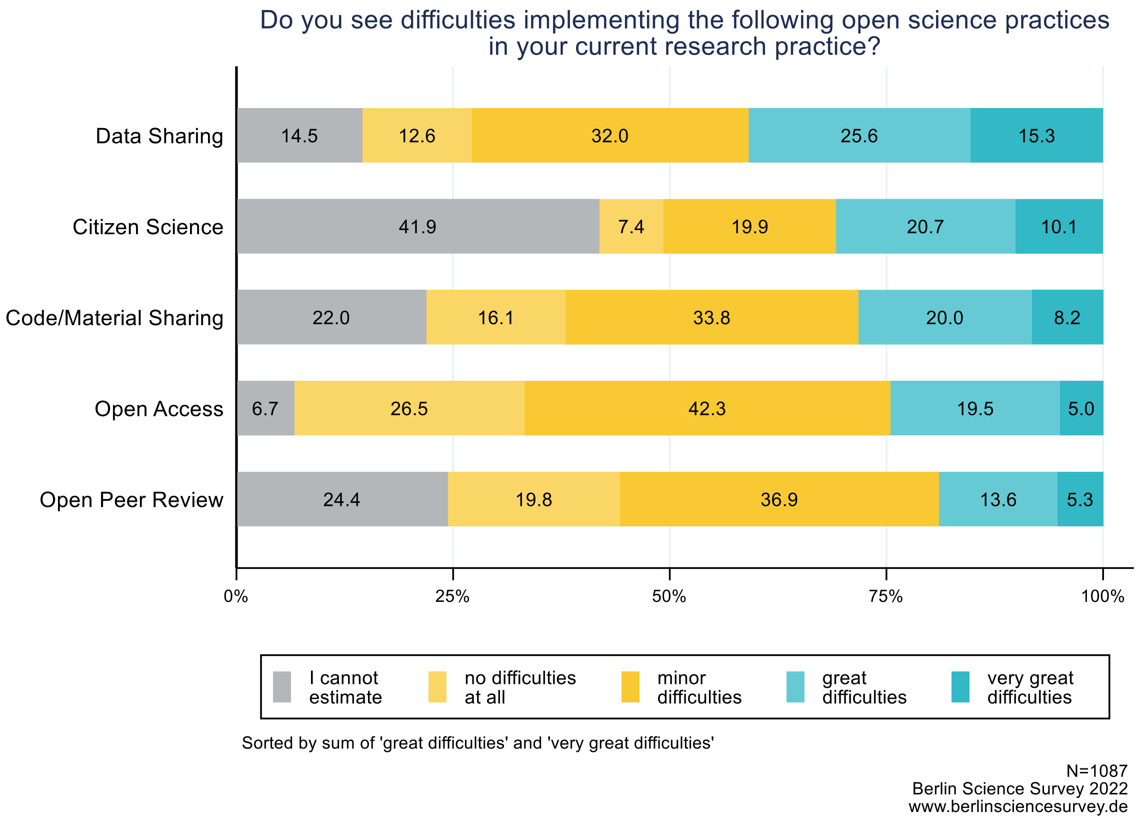

Figure 22 Difficulties in implementing Open Science practices

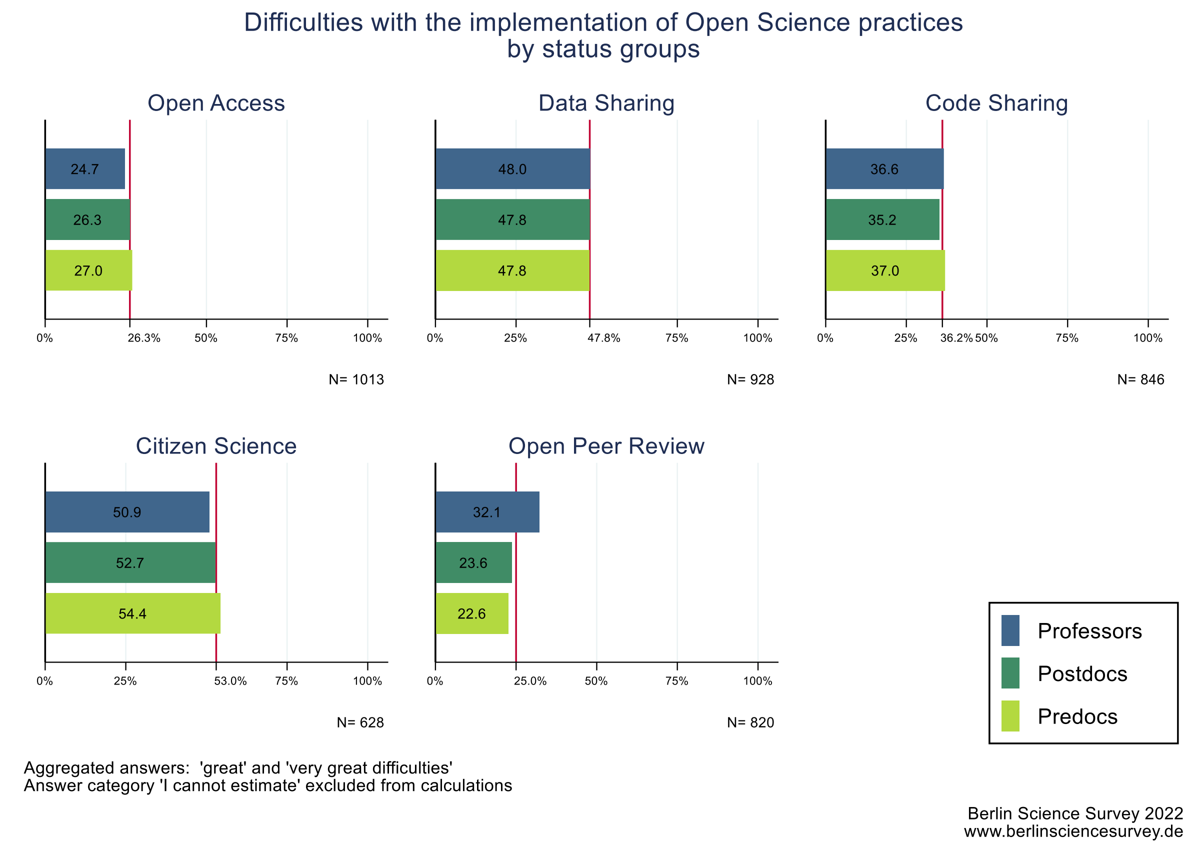

Figure 23 Difficulties in implementing Open Science practices, by status groups

The extent of the problems in implementing open science practices is assessed significantly differently depending on subject groups (see Figure 24). Humanities scientists see great or very great difficulties in all five open science practices more often than average. It is also striking that the natural scientists are significantly less likely than the other subject groups to report difficulties in implementing both data and code /material sharing. Thus, they form the contrast profile to the social scientists, who see difficulties in sharing practices more often than average. The type of data plays a major role here. If data is personal or even sensitive, qualitative or difficult to anonymize, then this sometimes presents major hurdles for provision.

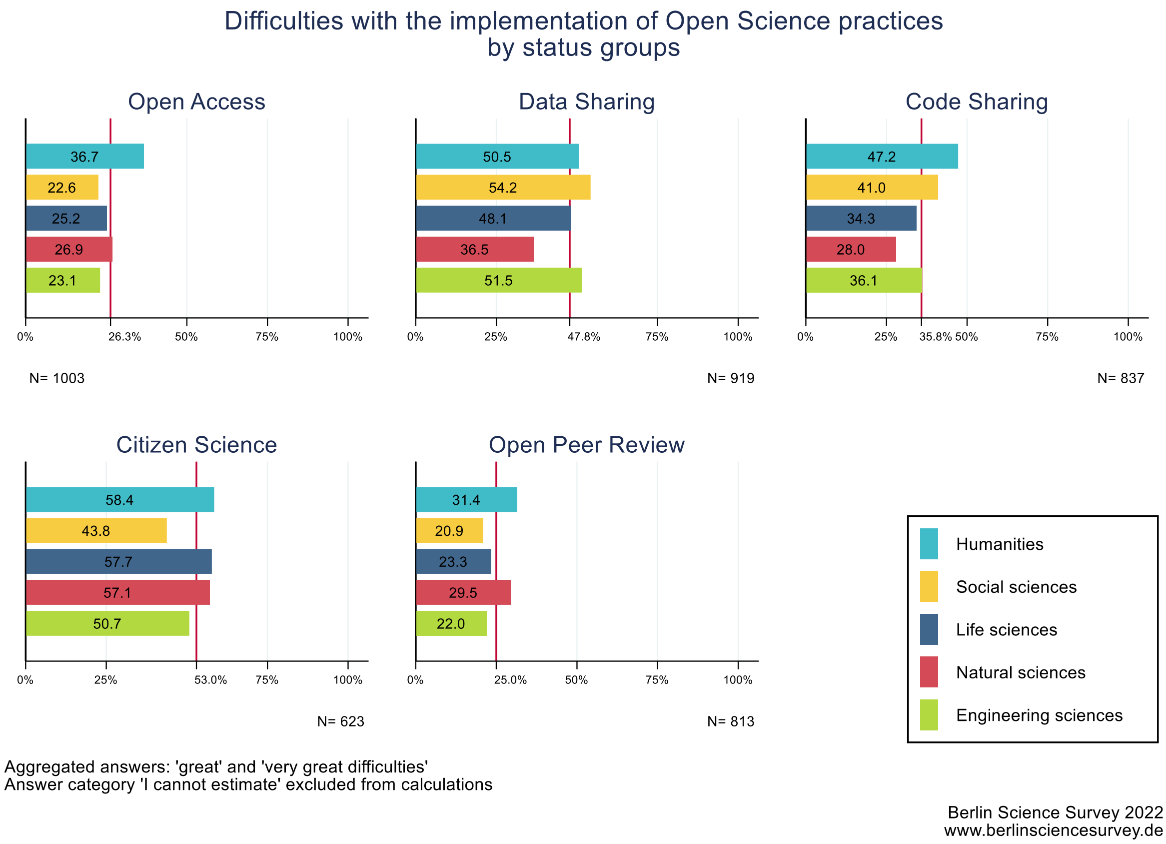

Figure 24 Difficulties in implementing open science practices, by subject groups

4.2 Need for Support from the Institutions

Since, overall, the hurdles to implementing open science are still considerable, the question arises as to what extent institutions can provide support in eliminating difficulties. The respondents were therefore also asked about the need for support in the implementation and expansion of open science practices by their own institution. On average, 40.5% indicated such a need for support (see Figure 25). Differentiation by status groups shows that professors are the least likely to indicate such a need, and non-doctoral scientists the most likely (see Figure 25). A comparison of subject groups reveals an above-average need for support among engineering scientists and social scientists (see Figure 26).

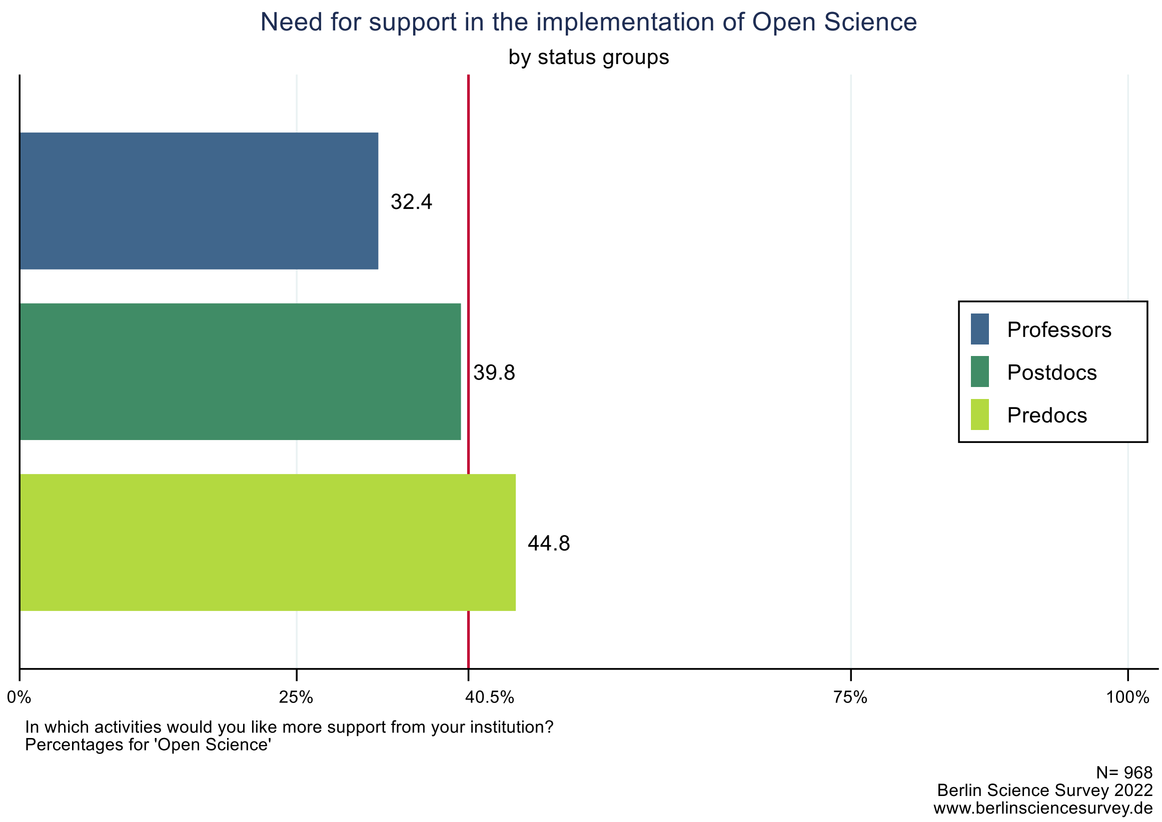

Figure 25 Need for support with Open Science, by status groups

Overall, it is clear that there are still many difficulties in implementing open science practices. Even in the case of already well-established open access publishing, almost a quarter of the respondents still see difficulties. Accordingly, the expressed need for support is also relatively high, but this also varies between status groups and research contexts.

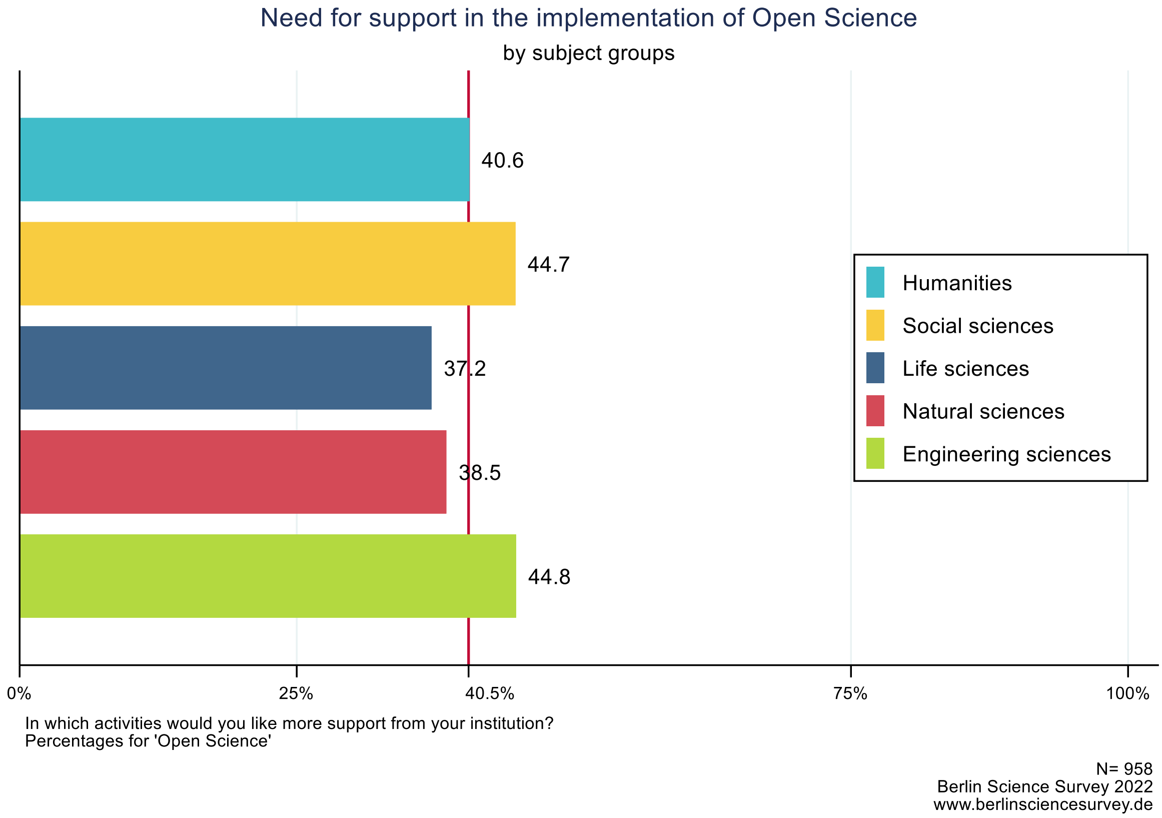

Figure 26 Need for support with Open Science, by subject groups

4.3 Assessment of the Berlin Research Area with regard to Open Science

In order to gain a comprehensive insight into the research realities of the scientists, they were finally also asked to assess the Berlin research area with regard to various aspects (Lüdtke and Ambrasat 2022a). The implementation of open science was rated as less good compared to other goals. Only a share of 39.7% of the respondents assess this aspect of the Berlin research area as "somewhat good" or "very good". Although 32.8% of respondents to the survey on the topic of open science say that they are unable to assess it for the Berlin research area (see Figure 27), even if these respondents are excluded from the calculation, the result for open science is only a slightly positive assessment of 59.1% (Figure 28).

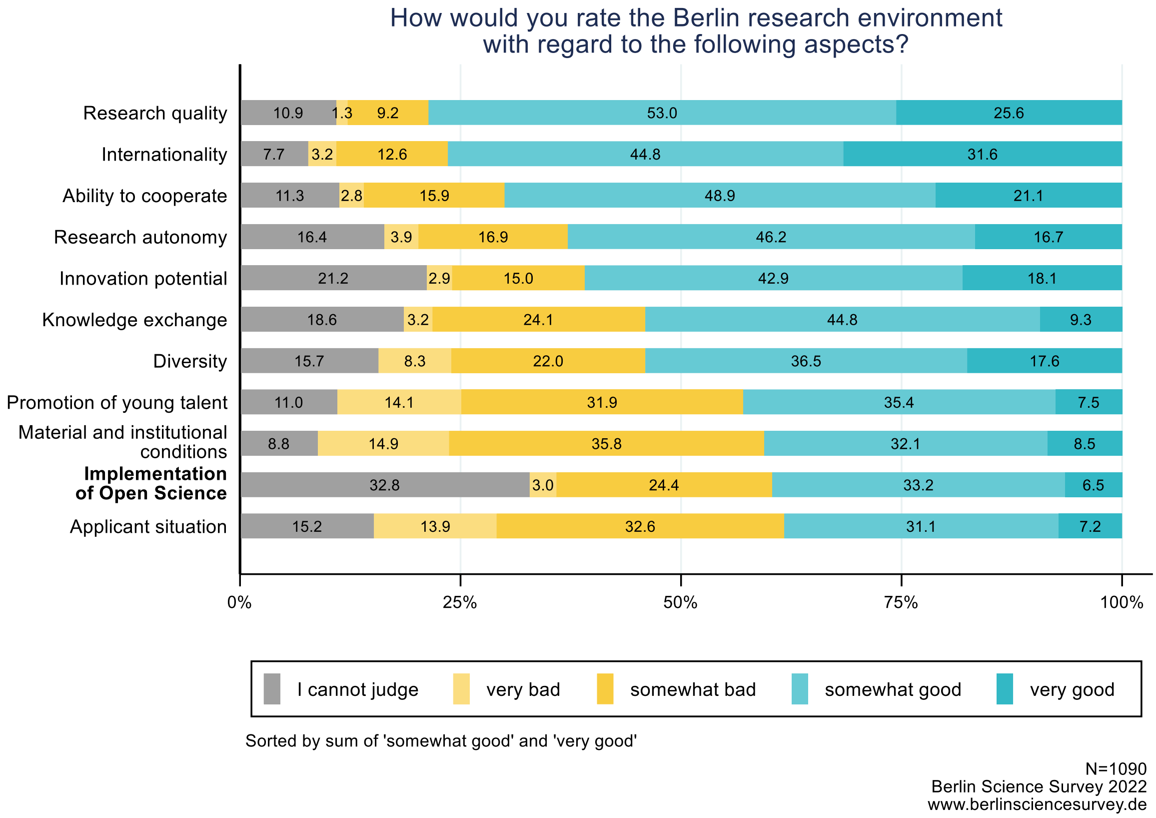

Figure 27 Assessment of the Berlin Research Area

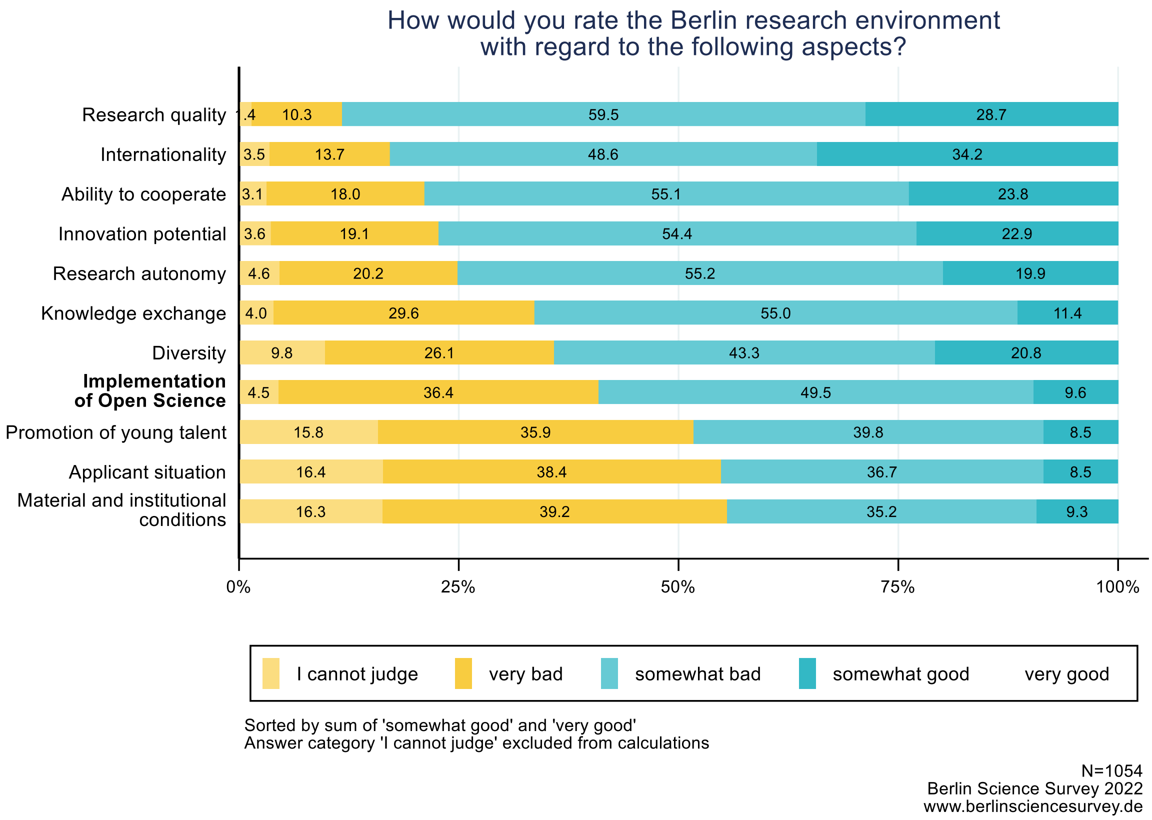

Figure 28 Assessment of the Berlin Research Area, without "I cannot judge"

5. Conclusion and Outlook

In this report, the results of the pilot study of the *Berlin Science Survey* on open science were presented in detail. Open science is an umbrella term, holding different scientific practices for improving accessibility, traceability and reusability of scientific results. The *BSS* addressed open access publications, data sharing, code and material sharing, open peer review, and citizen science.

There are clear discipline-specific differences in the frequency with which the different open science practices are implemented. On the one hand, this is evidence of a culturally varying degree of dissemination, but on the other hand it indicates that some practices are more relevant for certain research contexts than others. This is because the various open science practices have different implementation possibilities in particular research contexts and cannot be implemented in the same way by all scientists. Steering policy implementation concepts must therefore consider the respective research contexts and research cultures.

The attitudes towards the expansion of open science are positive among the vast majority of scientists. The positive attitudes are supported by assessments of the expected effects of open science for the science system, where the expectations of positive and useful effects for science outweigh the perception of dangers and risks.

In contrast, fewer scientists see a personal benefit from open science. Especially the younger scientists expect an improvement of the research situation.

Overall, there is a positive correlation between attitudes and practice: those who practice open science more frequently or regularly also have more positive attitudes toward open science and are more open to its expansion.

There are still problems when it comes to implementing open science. Even in the case of already well-established open access publishing, almost a quarter of respondents still see great or very great difficulties. There are differences in status groups and, above all, in subject groups. Thus, it is necessary to consider the diversity of research contexts and situations in which researchers work in order to reduce existing difficulties and hurdles in a targeted manner.

Future investigations into open science should seek to identify research contexts with particular difficulties in order to target measures for realistically improving its implementation. Such detailed investigations go beyond the possibilities of pure cross-sectional surveys, so that it is recommended to use mixed methods here, in particular in-depth qualitative methods.

The *Berlin Science Survey* is designed as a trend study and will regularly re-evaluate the developments of research practices and attitudes of scientists in the Berlin research area towards open science.

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Tables and Figures