

Peer-review procedures as practice, decision, and governance—the road to theories of peer review

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Peer review is an ubiquitous feature of science with three interrelated roles: first, as a mechanism to assess quality through expert judgement (process); second, to decide on the distribution of scarce resources, e.g. publication space (outcome); and, third, to self-govern science (context). This is poorly reflected in public and academic debates, where attention is focused on alleged deficits. Moving beyond a ‘deficit model’, we, first, divide the peer-review process into eight different practices, which, in combination, can make up a wide variety of peer-review procedures. Second, we claim that peer review not only provides evaluative decisions, but, more importantly, also provides the legitimacy for these decisions. Thus, an encompassing theoretical view of peer review should integrate process, outcome, and context. Such a view could start by theorizing peer review as a form of government, not unlike democracy, grown historically around concerns for legitimacy, responsibility, and responsiveness akin to the Mertonian norms.

Keywords: peer review; governance of science; science and democracy.

1. Introduction

Peer review is an ubiquitous feature of science dating back to the 17th century. As the basic and most adequate form of quality control, peer review seems irreplaceable to most scientists. Despite its central importance and long history, peer review is mainly discussed with respect to its deficiencies. Public debates have the tendency to either accept peer review as the gold standard for scientific knowledge or to focus on some of its deficiencies and implying that serious reform is needed. Little is said about the merits of peer review and the mechanisms that make it work. As a consequence, attempts to reform or improve peer review primarily aim at eliminating or alleviating such deficiencies. Concentrating on the shortcomings offers only a limited understanding of how peer review works, and measures to address deficiencies may have significant and negative unintended consequences as a result. In light of the many current calls for reform in how quality is controlled in science (responsible research and innovation, translation, reproducibility, misconduct, Coalition for Advancing Research Assessment), a more comprehensive understanding of how peer review works is urgently needed.

Some of this focus on deficiencies has carried over into the research literature. Peer-review research started as a reaction to public criticism, most notably with political concerns over cronyism, exemplified by the work of Cole and Cole in the 1970s (Cole, Rubin and Cole 1977; Cole and Cole 1981; Baldwin 2018). By and large, it has retained a focus on perceived deficits and ways to improve on them up to the present. As such, it is perfectly attuned to the need in public debates for evaluative judgements and quick guides for action. However, the field has, at the same time, become bigger and

more diverse, so that the time may have come to challenge the premises of the deficit model and ask for a more encompassing understanding of peer-review processes. Despite the large number of empirical studies, a more generalizable discussion of how peer review works as a procedure for quality control and what useful theoretical renderings of this process might look like is still missing (Hug 2022). Such a discussion is sorely needed to move the field from primarily evaluative to more scientific perspectives (Hirschauer 2004).

Instead of providing a fully fledged theory of peer review, our goal in this paper is a preliminary one. We, first, argue for a more comprehensive definition of peer review as a social phenomenon and relate it to the existing literature. We, second, elaborate on common premises of conceptualizations of peer review in existing (empirical) research, on which theories of peer review can be built. We argue, third, that a common understanding includes peer review as a procedure to assess quality, peer review as a mechanism to decide on scarce resources, and peer review as an instrument for (self-)governance in science. The primary focus in the literature has been on peer review as a decision mechanism, from where we expand on what it means to conceptualize peer review as a procedure for quality assessment and as an instrument for governance. Based on a simple typology, we conclude by integrating these three understandings and suggesting the main theoretical concerns that future theories of peer review may consider. These concerns result from the claim that the success of peer review is predicated on it combining issues of scientific quality with issues of political legitimacy that remain inseparable for any empirical analysis.

2. Definition(s) of peer review

If peer review is considered any procedure in science that is used to allocate scarce resources by invoking expert judgement on the epistemic qualities of an object, then peer review is a highly diverse phenomenon with a long history. Objects can be papers, books, research projects, people's careers, funding programmes, or organizations. Epistemic qualities can be disciplinary, interdisciplinary, or even transdisciplinary. Expert judgment can be individual, collective, or even algorithmic. And scarce resources can be publication space, funding, careers, attention, and prestige.¹ As such, peer review encompasses many, if not most, of the institutionalized procedures of evaluation in science: journals, books, conferences, funding, professorships, and a myriad of institutional and programme evaluations (Jasanoff 1990). Such a definition should cover most of the diversity of peer review as a social phenomenon.

As a definition of peer review, this is more encompassing than the everyday usage of the term and more encompassing than how most of the literature frames the phenomenon.² It is generally seen as self-evident that peer review differs with respect to what objects are reviewed (e.g. papers versus funding proposal) or with respect to the institutional setting (e.g. journals versus funders versus universities).³ We think it worth to reconsider the self-evidence of separating multiple forms of peer review analytically for historical and theoretical reasons, as we explain below. A simple example to see that less encompassing definitions are limiting are the recurring claims of a shortage of reviewers. Addressing such an issue requires including all forms of peer review in the analysis because reviewers are typically active in more than one form of peer review and a shortage of reviewers may be due to how the demand for reviewers varies across multiple forms of peer review.⁴ The historic origins of peer review can be traced back to the scientific associations, such as the Royal Society, from the 17th century (Barnes 1934; Webster 1967; Zuckerman and Merton 1971; Lock 1985; Kronick 1990; Biagioli 2002; Spier 2002).⁵ These initial forms of evaluative witnessing (Shapin 1994) and selecting were mostly informal and local. Even though they spread alongside the growth of the science system, peer review only evolved into an ubiquitous feature of science in the second half of the 20th century (Jasanoff 1985; Guston 2000; Baldwin 2018).

The rise of peer review must be regarded in the context of increased and more specific public funding for research after the Second World War (Jasanoff 1990; Guston 2000). Baldwin's (2018) account is highly instructive here as she pinpoints the moment in US-American politics in the 1960s and 1970s when referring to peer review became taken for granted: on the one hand, when public spending on research had to be justified and, on the other, when the quality of research had to be publically ensured. From that point on, peer review became the procedure that regulated the boundary between science and politics, and more generally between science and society (Guston 2000, 2001; Weingart 2001). It became successful in this role, not because there was convincing evidence that peer review would be the best procedure, either epistemically or politically, to regulate science. Rather, it became a matter of course because it represented the consensus between political and scientific actors. The history of how peer review proliferated to become the normal procedure, also in journals or institutional evaluations, remains to be written,

but the political consensus around research funding after allegations of financial mismanagement and of cronyism will play a central role. As such, peer review itself only became a contested issue when allegations could be made that it has serious deficiencies. Since then, public debates about peer review have little to say about its merits and much about its flaws.

3. The 'Deficit Model' of peer review

The list of alleged flaws and deficits is long and has changed little over the last 40 years: conservatism, corruption, bias, lack of transparency, inefficiency, ineffectiveness, low reliability, low validity, overburdened reviewers, and much more (Reinhart 2012: p. 50ff, Eve *et al.* 2021: 8). It seems that these recurring allegations have less to do with how peer review actually works and more with how important peer review has become. Whatever the overarching contested issue is at the time—interdisciplinarity, translation, responsible research and innovation, reproducibility, misconduct, etc.—peer review is always part of the debate. Due to its centrality, it must at least be either part of the cause or part of the solution for such problems. Whatever the problem, it is due to the deficits of peer review, and the way forward lies in peer review reform or in alternatives to peer review. At least, this is how these public debates always seem to play out. We call this the 'deficit model': peer review is only of interest when problems arise then calls for urgent changes follow. The way peer review actually works, however, is taken for granted and requires no immediate action.⁶ Along the lines of a famous quote by Winston Churchill, the perennially recurring slogan for the deficit model can be summed up as: peer review is the worst form of quality control, except for all the others.

It seems then that these public debates are only secondarily about peer review. If they were primarily about peer review, one would expect the script for such debates to change over time according to the current state of research on peer review. The question of whether one of the proclaimed deficits is actually prevalent could be resolved through research, e.g. whether there is gender bias or not, and the debate should change accordingly. It seems that this is not happening, even though the number of empirical studies on peer review has been growing considerably (Batagelj, Ferligoj and Squazzoni 2017; Grimaldo, Marušić and Squazzoni 2018). Gender bias is still a contested issue both publicly and in the research literature (Squazzoni *et al.* 2021). The fact that 40 years of research have not convincingly shown that these deficits are real and problematic—not just in single cases, but for peer review in general—prompts us to explore theoretical options beyond the deficit model.

We think that this state of affairs has at least three causes. First, most empirical studies employ a case-study approach (e.g. of one journal or one funder), and comparative work is very rare. Second, most studies have relatively small sample sizes and the robustness of results suffers accordingly. Third, most studies follow the deficit model in that they primarily test for one (or several) of the alleged deficits of peer review and thus fail to give a comprehensive view of peer-review procedures.⁷ The first two causes would be easy to overcome if there were more access to data from journals, funding organizations, and governments. Despite national transparency and accountability laws and more researchers attempting to gain access to data, the field has seen only minor progress on this

front, and it still seems that limited access to data will be a central issue for the foreseeable future. The third cause, however, is more difficult to overcome and little progress has been made here.

Considering the abundance of public debate and research, it is surprising that there is very little theorization of peer review. Peer review is frequently introduced as playing ‘a key role’ in science without much qualification as to what this key role implies. Most authors treat the role of peer review and thus its theoretical relevance either as self-evident or as pertaining to a deficit.⁸ Whether a deficit relates in an important way to what the role of peer review is in theory is rarely discussed. As a consequence, there seems to be a need for specific rather than general claims as to what the role of peer review is and how such claims help in determining what research questions can be deemed relevant. Overcoming the deficit model will therefore require making explicit (and testable) claims about the role of peer review that relate to the general sentiment that peer review is ‘one of the fundamental conditions of possibility of academic knowledge and the construction of its value’ (Biagioli 2002: 11). In addition, such theoretical claims may also help explain why the deficit model has become the most prevalent folk theory of peer review.

In summary, the empirical literature on peer review makes it difficult to draw generalizable conclusions about peer review, as individual studies focus on just one case, or say little about their theoretical (i.e. generalizable) framework, or follow a deficit model, often implicitly. Similar criticism has been voiced earlier, e.g. by Hirschauer (2004); Lamont (2009); Reinhart (2012), or Hug (2022), and still seems relevant today. We think the way forward is to use a more inclusive definition of peer review, which, as explained above, comprises ‘any procedure in science that is used to allocate scarce resources by invoking expert judgement on the epistemic qualities of an object’; for this allows for more comparability between individual studies and to work towards more explicit theoretical models that allow for more generalizable insights. Historically, these premises can be justified by recognizing that peer review has been a changing and diverse phenomenon, both diachronically and synchronically, and by recognizing that the legitimacy and success of peer review is predicated on its role at the nexus of science and society, i.e. science and politics.

4. A potential basis for theories of peer review

While the deficit model informs much of the public discussions on peer review, e.g. in editorials, it also provides a frame for the research literature that is mainly focused on finding out whether everyday criticism of peer review has some validity. Public debates and research literature seem perfectly attuned: one proclaims a serious deficit at the heart of science (conservatism, bias, inefficiency, etc.), while the other sets out to prove or disprove the critics empirically. However, since this back and forth is not anchored in theoretical debates, the potential for generalizable understanding remains limited. Why and how peer review works beyond its deficits as a procedure for quality control and (self-)governance has been a peripheral topic at best (Neidhardt 2016). To move beyond the predominant focus on the decisions and outcomes of peer review and beyond the deficit model with its evaluative orientation (Hirschauer 2005; Sabaj Meruane, González Vergara and Pina-Stranger 2016),

we fall back on very basic assumptions about the role of peer review.

In a very general sense, peer review does not just consist of outcomes, but rather these outcomes are produced by a process within a certain context. Abbott (2016) provides a perspective that binds these three elements (process, outcome, and context) together in a highly abstract theoretical fashion. We concretize the two underdeveloped elements for the case of peer review by drawing on the work of Stefan Hirschauer (for process) and Friedhelm Neidhardt (for context). An ethnographic perspective reveals that a series of interrelated practices make up a peer-review procedure, such as various forms of reading, editorial discussions, or joint revising of texts (Lamont 2009; Mallard, Lamont and Guetzkow 2009; Hirschauer 2010; Pontille and Torny 2015; Horbach and Halfman 2019; Eve et al. 2021). A contextualizing perspective indicates functions peer review fulfills beyond decisional outcomes; it legitimizes these decisions to a diverse set of audiences (first among them scientists themselves and actors in science policy) and, as a result, also legitimizes itself as an institution to (self)govern science (Neidhardt 2016; Guston 2000; Jasanoff 1985; Horbach and Halfman 2018, Forsberg et al. 2022: 1–36). To relate these processual aspects of peer review to their legitimate context, Niklas Luhmann’s concept of ‘legitimation by procedure’ (1983) is helpful as it allows decisions to be analysed not as self-evident because they represent the truth, but instead as acceptable because they are recognized by a community of stakeholders.

In a more vernacular language, these three elements (process, outcome, and context) can be summarized as three interrelated claims about the role of peer review, which can also be found either implicitly or explicitly in much of the empirical literature: peer review is a mechanism used to assess quality based on expert judgement; peer review is a decision mechanism used to decide on scarce resources, such as publication space, funding, or employment; peer review is an instrument for self-governance in science (Reinhart 2012: 189ff).

5. Practices (i.e. process): activities in peer review

In order to understand peer review as a process, it is necessary to first consider the actual practices that make up a peer review procedure. Even though peer review comes in many forms and even though ethnographic descriptions of a variety of processes are rare, a limited number of frequently occurring practices can be discerned. We propose differentiating between at least eight such practices that occur as purposeful activities. As individual elements, they can be found in many peer-review procedures, and by combining them, they can be used to describe most procedures, ranging from very simple to very complex ones.⁹

5.1 Postulating activities

The submission of a manuscript, a grant proposal, or a job application is a request for approval of the related claims. These claims can be on publishability, on funding, or on hiring. We call these the postulating activities and they create the imminent cause for setting in motion a procedure that evaluates and decides on such postulates.

5.2 Consultative activities

The reviewing by experts is often seen as the core element of peer-review procedures. They can be performed remotely, e.g. when external reviewers write their review, or on site, e.g. when designated reviewers present their assessment orally in face-to-face meetings. We call these consultative activities as they represent the evaluations from expert advisors. These evaluations (and the experts) are often directly linked to debating or decision-making activities (see below); however, we treat them separately because they are often separate also in practice.

5.3 Decision-making activities

The primary outcomes of peer-review procedures are decisions to accept or reject postulates. These decisions are based on decision-making activities that are informed, e.g. by grades, rankings, reports, presentations, or discussions and that are mostly separated from consultative activities (e.g. when a panel discusses the scientific merit of postulates individually and then moves on to rate or rank them comparatively).

5.4 Administrative activities

Administrative activities are usually provided by organizations that use peer review, such as journals or funding organizations, and are carried out by their representatives such as editors, editorial managers, or staff of funding agencies. They include subsidiary tasks such as receiving and distributing postulates, setting dates and agendas, general communication between all the parties involved but can also include more substantial tasks such as searching and selecting reviewers. To define administrative activities as a distinct practice accounts for the organizational framework in which most peer-review procedures are embedded (journal, funding agency, universities, etc.).

5.5 Debating activities

We define debating activities as the processes in which the reviews, notes, and evaluations that contribute to the assessments are exchanged, commented, and discussed. The debating practices take place, for instance, in editorial boards, reviewing panels, or appointment commissions and can contain written reviews, memos, speaking notes, numerical votes, or oral contributions.

5.6 Presenting activities

We refer to processes as presenting activities in which the postulating authors or applicants for grants or jobs introduce themselves and present their proposal and answer questions. In these activities, the postulators are involved directly in the evaluation process. This happens mostly in more complex and multi-stage peer review, such as job applications, personalized grants and collaborative project funding, for instance, in the case of on-site visits and inspections.

5.7 Observing activities

We classify these activities as the processes in which the assessment is monitored in order to control procedural compliance with regard to the respective tasks, rights, and duties of each role, its course, and the overall objective. These activities

often require the results to be documented or reported to the decision-making authorities.

5.8 Moderating activities

The regulated procedure as such requires moderating activities that accompany and, if needed, explicate and (re)explain the processes. The more complex the procedures are, the more the interplay between different activities needs to be explicitly concerted and aligned throughout, for example, by introducing and guiding participants in the procedure. This can also mean chairing the meeting during discussions.

6. Deriving procedures from practices: types of peer review

The different activities correspond to specific tasks and responsibilities, some executed by different, some handled by the same persons but in separate phases of the procedure. To be specific, the postulating authors or applicants themselves are never involved in consultative or decision-making activities in relation to their own proposals, but are potentially involved in the evaluation of other postulates. Depending on the procedure, consultative and decision-making activities can be carried out one after the other by the same person, or they can be strictly separated. In the latter case, it is often the report created during the observing activities that provides the basis for the decision on the results of the consultation and discussion.

The great variance in peer-review procedures in terms of effort and complexity is also due to the fact that all of the activities mentioned above can be carried out by multiple people, but hardly any of them necessarily require more than one person. Postulates can be submitted and presented collectively or individually according to preference, disciplinary convention, or funding. The administrative, moderating, and observing activities are presumably assigned according to the number of postulates, the narrow or broad thematic scope, the length and complexity of the procedure, and the available resources. In the course of consultation, multiple reports are usually required in order to obtain a variety of perspectives, but this requirement is not always met. Therefore, only the debating activities, in which different opinions are debated and weighed against each other, are necessarily collective. In the case of journal editors, who sometimes still decide alone on the acceptance and rejection of manuscripts, their activities remain collective to the extent that their decisions are founded on expert reviews.

Building on this, we can now discern different types of peer-review procedures, by asking which activities need to be present at the least for a procedure to be called peer review and how complex procedures can get, when combining many of these activities.

At a minimum, a peer-review procedure requires a postulating activity, a consultative activity, and a decision-making activity in which the postulate is accepted or rejected. This may be seen as an edge case, however, because the frequent practice of sending a manuscript to colleagues, who then make comments, whereupon the author decides on how to proceed with the manuscript, contains all three activities in a minimal form. The question, thus, arises as to whether a basic understanding of peer review must include an administrative activity, in which postulates are received and their

Table 1. Combination of activities in peer-review procedures from minimum to maximum.

Minimum	Additionally, up to the maximum
Postulation	Discussion
Administration	Presentation
Consultation	Moderation
Decision	Observation

processing is initiated and coordinated. As mentioned above, as an instrument for self-regulation in science, peer review is always embedded in an organizational framework, in which administrative activities take place (see Neidhardt 2016: 271; Reinhart 2012: 150–155). In light of this, we define a minimal peer-review procedure as containing four activities: postulating, administrative, consultative, and decision-making.

The spectrum's other pole is marked by a maximum procedure, which can be found in the application for long-term funding or large-scale research collaborations. Here, more elaborate peer-review procedures are used, which, in addition to the four basic elements also contain debating, presenting, observing, and moderating activities. The maximum peer-review procedure is thus composed of all eight elements (see Table 1).

7. Peer review in context

The variety of peer-review procedures can be seen as the result of the many possible combinations and variations of these eight elements. This, however, raises the question as to why so many combinations, and thus variants, of peer review are needed. A naive understanding of scientific self-governance would assert that peer review is all about expert judgement and, thus, the only relevant aspect is finding the best peers who will 'know quality when they see it'. From such a view, the many variations of peer-review procedures seem unnecessary. Moving beyond the deficit model and recognizing the procedural differences, however, prompts us to ask about the context in which peer review is used and which functions it fulfills, either with individual elements or combination of elements. Stefan Hornbostel (2016) suggests that evaluation procedures in science can fulfill six different functions: the *knowledge function*, in which the evaluation provides information on the nature, effect and efficiency for the participants; the *control function*, which ensures compliance with target values and auditing procedures; the *dialogue function*, which serves to stimulate self-understanding and communication processes; the *legitimation function* for decisions and accountability; the *evidence function*, in which meta-analyses are carried out in order to make evidence-based decisions; and the *public function*, which is constitutive for ratings and rankings (Hornbostel 2016: 245).

We assume that all peer-review procedures serve multiple or even most of these functions in one way or another. Furthermore, individual elements of procedures may serve more than one function over different procedures or even within the same procedure. We see these six functions as a heuristic to move away from common sense understandings of peer review and to emphasize the move beyond the deficit model where quality and legitimacy are the result of process, outcome, and context. As such, we suggest some frequent

combinations of elements and functions to move towards the more general question as to how they produce quality and legitimacy.

With respect to quality, the knowledge function is often served by a combination of postulate, consultative reviewing, and discussions in presenting and debating activities. This can go hand in hand with the dialogue function when the postulate is accompanied by presenting activities and a Q&A session, continued and deepened in debating activities (e.g. in panel or board sessions), and resulting in feedback to those who submitted a postulate. Knowledge about the scientific quality of postulates must be explicated in peer-review procedures, providing the basis for a dialogue about quality. The close relation between knowledge and dialogue has prompted Hirschauer to address peer review primarily as a communicative process.

With respect to legitimacy, the control and legitimation functions are decisive. Control is exercised by means of publicly accessible information on opportunities for publication, funding, and jobs, including the respective rules such as who is eligible to postulate or what the relevant quality criteria will be. As this is public information, it serves as the basis for accountability towards the relevant scientific communities as well as towards further stakeholders, e.g. in politics. In addition, elements of administration, moderation, and observation provide control and legitimation as internal and organized parts of peer-review procedures. Control, legitimation, and public functions of peer review connect internal and external aspects of how procedures produce legitimacy. This close relation has prompted Reinhart to address peer review primarily as an organized or organizational process (Reinhart 2012: 123ff).

The various types of peer-review procedures ranging from more minimalist to rather maximalist procedural forms thus reflect different functional demands from different stakeholders, such as the readers, the scientific community, the citizens as taxpayers, academic colleagues, university staff, scholars, and students. Hence, the complexity of peer-review procedures and their elaborate design are also determined by the variegated pressures for legitimacy. This can be further predicated on the sustainability of staffing or funding, the amount of financial resources allocated, or the reputation of the funder, journal, or position.

8. Peer-review procedures producing quality and legitimacy

The manifold practices and functions that make up the diverse sets of peer-review procedures demonstrate that determining the quality of scientific work is only part of the role played by peer review. Equally important is that these procedures also provide legitimacy for these judgements on quality. That is, in essence, what procedures do in general (Luhmann 1983). Separating the quality and the legitimacy aspects is impossible in practice because of the processual nature of peer review. However, our typology of practices makes it possible to address how different peer-review procedures combine these elements and thus produce combinations of quality and legitimacy that are context specific.

With regard to ensuring quality, those procedures that ascribe great importance to consultative reviewing (e.g. journals) derive their quality assurance and legitimacy to a large

extent from the competent written expert opinions and their subsequent discussion. Those procedures that provide considerable time and space for presenting and debating activities (e.g. panel assessments) complement the legitimacy based on written expert judgement and also draw legitimation from discursive and deliberative elements. If observing activities are also highly developed, standards such as compliance with procedural requirements to ensure equal treatment and avoid bias are also invoked as legitimation-relevant features. In this respect, it is also instructive to see who guarantees that a procedure unfolds as fairly and impartially as possible. This task is often performed by representatives of the organizations. If observing activities overlap heavily with administrative activities, legitimacy through procedure is presumably very pronounced and generally weighty. If observing activities overlap strongly with consultative and debating or even decision-making activities, it is questionable whether the separation of roles can be maintained without assigning them to separate people. Otherwise, the allegation might be raised that these activities are not effective and, thus, are 'just for show'.

Concerning legitimation through procedure, we can assert that the more complex and multi-levelled the procedures are, the more pronounced the separation of functions and personnel and the division of labor are, the more legitimacy is based on the procedure itself. As a result, different procedural types of peer review imply different techniques to provide quality assurance and legitimacy because the way in which the different activities are combined affects the way legitimacy is generated through procedure. This is not to say, however, that procedures produce legitimacy irrespective of who participates in them. The power of peer-review procedures to decide on scarce, and thus contested, resources seems to be predicated on scientists playing roles that are seen as key to the procedure. If only other scientists are involved, the scientific community is the central stakeholder, whereas the inclusion of representatives of the funding organizations or other stakeholders are signs that, e.g. science policy or the public are also addressed and affected to some degree.

9. Implications for science and politics

Our claim at the beginning of this paper was that the deficit model is tied to a mostly implicit theory of peer review that mainly focusses on the results, that is to say the decisions, of procedures. Research questions about peer review thus centre around issues such as reliability, validity, and fairness. What is neglected by such accounts are two commonsensical aspects of peer review that make decisions both possible and relevant: process and context. By exploring these two aspects, we have shown, first, that the processes through which decisions are reached are highly diverse and practically complex. As such, they incorporate a multitude of practices and criteria that are difficult to capture solely from outcomes. We have illustrated, second, that the contexts of peer-review procedures extend beyond scientific communities of shared quality standards and that these extended contexts co-determine the outcomes. By giving equal weight to the process, decision, and context aspects, we conclude that the role of peer review lies in inextricably linking the quality and legitimacy of judgements about scientific work. In other words, peer review is as much about science as it is about politics. Theorizing peer review should therefore start from the notion that the primary role of

peer review is to link self-governance and external governance of scientific work.

Starting from this notion, theoretical claims about peer review can be taken in different directions. Some possibilities were mentioned above; e.g. peer review as (boundary) organization or peer review as a communication process. Merton famously linked 'science and the social order' through the democratically inspired scientific ethos, which had organized scepticism, i.e. peer review as one of the four norms (Merton 1938, 1968). Following up on that Mertonian intuition our account here could be used to balance the normative with the processual aspects of peer review. Drawing additional inspiration from Foucauldian perspectives, we can ask: Who governs through peer review and who is governed by it? With reference to the distinct activities and our typology of minimum and maximum procedures, we can discern three spheres in which governance in and of science through peer review calls for legitimation: scientific community, science politics, and society, which respectively encompass scientists, including researchers in humanities and social sciences, politicians, and citizens in general as the populations being governed. Hence, these spheres overlap, for example, in 'boundary organizations' (Guston 2000) such as national research agencies or coincide with societal concerns.

In the *scientific community*, self-governance through peer review is legitimized by safeguarding the professional competence of the assessments, guaranteeing an intersubjective coordination of the judgments between several experts from within scientific communities, and providing a functional separation of roles and division of labor (Reinhart 2012: 125, 176, 183). This sphere deals with the creation of legitimation by procedure with regard to quality assessment in the scientific community. Its main concern is the sphere of science policy, representing an already external governing authority given that it assures the legitimacy of the decision. In essence, it consists of making an adequate selection of articles worthy of publication, research projects eligible for funding, or job applicants competent to occupy the position because in this way, the scientific system shows it is capable of making gradual decisions within the disciplinary communities.

The distinction between legitimation addressing the scientific community and legitimation addressing concerns of *science policy* lies at a procedural level. In both directions, the objective is 'to do justice to the matter', i.e. to carry out an evaluation appropriate to the object in question, and this requires the criteria that have been put in place to be explained. For only then can the decision be justified and made plausible by means of outlined criteria—which can include science policy arguments and reasons—both to the scientific community and to actors in science policy.

The governance of the *societal sphere* involves the justification of peer review as an adequate mechanism of self-regulation in science, in some way supervised externally and governed by science policy actors. This means that peer review also justifies itself and the form of governance it provides to other societal spheres, especially since the logic of other spheres is already making its way into peer-review procedures in the form of publishers pursuing economic interests and public funds or foundations with latent political interests. Thus, the legitimacy of procedures rests on orders of justification (Boltanski and Thévenot 2006) and is always a political issue.

The three spheres of governance for and in which legitimation is generated are linked and refer to each other. For example, trust in peer review as a functioning decision-making mechanism itself can only be maintained if procedural legitimation can be used as a justification in cases of doubt, retraction, or possible misconduct. Inversely, comparing different interpretations and assessments of various dimensions of the evaluation requires weighting and a reduction in complexity, which can only be achieved taking into account specific decisions. Trust in peer review as a functioning mechanism for externally supervised self-regulation in science is therefore based on this reliable decision-making ability. By the same token, the quality of peer review also refers to the extent to which these communication channels between the three spheres of legitimation exist and can be made transparent and plausible if necessary.

Furthermore, the way in which the spheres of governance are linked with each other reveals the sources from which the legitimacy of peer review is derived. The triad of legitimation in peer review refers, first, to legitimacy immanent in science, which is ensured by means of the expert quality assessment of scientific contributions by competent peers. Second, it refers to the jurisprudence in which legitimacy is guaranteed by the neutrality of the judgement. ‘Although peer review is not a legal concept, it is invoked by scientists and academics as the axiom that informs most of their practices. It functions as an article in the tacit “Constitution” of the social system of science (not unlike the way democracy functions in the discourses of modern liberal economies)’ (Biagioli 2002: 13, see also end note 2). Third, selection and qualification as a competent peer draws on the political legitimacy of power, which is derived from the forms of representation of the population concerned, legitimized in procedural terms (by election, status, function, education, etc.). This once more reveals the relation to other spheres of society, especially to politics, in whose orders of logic and justification (e.g. academic reputation) the legitimacy of peer review is embedded.

The fact that peer review is as much about science as it is about politics has consequences, which reveal themselves in the way this form of governance is legitimized. It is now evident that the question of legitimizing a form of governance points beyond the realm of science and refers back to political and civic notions of legitimacy. From this perspective, the principles of democratic legitimacy identified by Pierre Rosanvallon (2018) are instructive. Accordingly, democratic legitimacy is based on impartiality, reflexivity, and even proximity to coexistent particularities (Rosanvallon 2018: 18).¹⁰ These distinguishable types of legitimacy are linked to three forms of social generality (Rosanvallon 2011: 7): legitimacy of impartiality to a ‘negative generality [...] by way of detachment from particularity’ (Rosanvallon 2011: p. 6); legitimacy of reflexivity to a ‘generality of multiplication [...] through multiplication of the expressions of social sovereignty’ (Rosanvallon 2011) and legitimacy of proximity to a ‘generality of attention to particularity [...] through consideration of the variety of situations [...] marked by concern for concrete individuals’ (Rosanvallon 2011). We can now pinpoint these criteria with regard to the shared concerns of the scientific community, science policy, and civic society as follows: Impartiality comprises a distancing of particular interests with respect to party positions or divergent

schools of thought. Transferred to peer-review procedures that comprises the employment of impersonal criteria and the commitment to restrict biases. Reflexivity is a necessary part of any culture of deliberation. It implies the consideration of different forms of knowledge and potential innovation according to multiple forms of expression of the common good. It hence consists in allowing for inquiries and corrections. Translated to peer review, it comprises evaluation, amendments as well as being open to revisions. Proximity entails to immerge into the peculiarity of various cases and multiple existing situations (Rosanvallon 2011: 5–8). Since societies conceive themselves as pluralistic, constituted by heterogeneous fractions, more than a simple majority principle is needed in order to achieve legitimacy that can cope with democratic claims, no matter the sphere of governance or governed collective from which they originate (Rosanvallon 2018). With regard to peer review it entails the recognition of different epistemological paradigms with respect to the equivalence of all particular interest groups or research approaches.

10. Peer review as a mechanism of government of science

This process-oriented approach identifies the nexus of quality and legitimacy as the central theoretical concern in the research on peer review. It has the advantage of being applicable to multiple forms of peer review (journal, grant, recruitment). Within the broad spectrum between minimum and maximum procedures, the different types and variants of peer-review processes can be understood as different modes of governance with regard to their function as an instrument for the (self) governance of science.

We speak of modes of governance because it is a matter of exercising power and agreeing on maxims to build and establish legitimate forms of control, i.e. ‘governmentality’ (Foucault 2005). In the case of peer review, power is exercised in the form of the decision on how scarce resources can be distributed as fairly and effectively as possible regarding scientific goals (furthering knowledge, innovation, and other social benefits) and in view of the diversity of possible paths leading to these goals. Consequently, we comprehend peer review as a mechanism of government because its decisions divide the population of the scientific community into those that govern and those that are governed, thus creating power relations.

From a governmental perspective, these issues of justice are usually discussed in relation to freedom and equality. In this respect, it is worth taking a look at the population of the scientific system in order to conceptualize the relationship of those who govern to those who are governed. First of all, this relationship is characterized by the way it operationalizes the idea of representation. When comparing the scientific community and civic society in this respect, some commonalities and differences are noteworthy: in the *scientific community* and in *civic society* those who govern in some way represent those who are governed on principles of impartiality, reflexivity, and proximity. The first notable difference is that the separation between those who govern and those who are governed is less pronounced in the scientific community. Scientists frequently switch between the roles of authors, reviewers, or editors. They are not fixed into either being governed or governing. They acquire first-hand experience in how the execution of power works, both from the view of those

that govern and those that are governed. In contrast, citizens in *civic society* are less often actively involved in governing. They mostly see themselves as being governed by professional politicians. And their relations to these politicians are justified as institutionalized forms of representation. First-hand experience in how the execution of power works is relatively rare and is often limited to the act of voting. The division of labor and separation of roles is institutionalized in representative democracy and made permanent by the professionalization of politics.

Moreover, according to Rosanvallon, three principles structure this relationship: legibility, responsibility¹¹ and responsiveness.¹² Legibility refers to the reception of information, with interpretative capacities being deployed leading to a comprehensive understanding of and acquaintance with the procedures and mechanisms of governing. These parameters are decisive for understanding how power relations are designed and how power is diffused and executed (Rosanvallon 2018: 157–161). In the scientific community legibility comes from actively participating in peer review on both sides of the reviewing process. A democratically literate scientific community means a community that actively comprehends the social world and the mechanisms governing it (Rosanvallon 2018: pp. 167–168). Hence, we consider this the prime principle for analysing governmentality in science as it allows for accountability and encompasses responsibility. In this sense, legibility characterizes the way in which the two central requirements of quality and legitimacy of judgement are met and specifically how they are mediated via expertise and representation or participation. As processual know-how, legibility is crucial for enabling competent participation. It can convey empowerment and diminishes the distance to power, its mechanisms, and its art of execution. Hence, legibility can be seen as a key element that allows for contribution to, involvement in, and appropriation of governing principles and thus responsive governance in science. For Rosanvallon, the three forms of social generality, democratic legitimacy, and the structuring principles of legibility, responsibility, and responsiveness underlie his ambition to understand democracy as an inseparable unity of ‘a mode of government and a form of society’ (Rosanvallon 2018: p. 205), whereby he draws on Durkheim. Transferring his insight to academia these terms and distinction might lead a way to connect the scientific community to its own modes of government.

The scientific community consists primarily of professional scientists and science managers. With regard to forms of participation, it is noteworthy that in both the scientific community and civic society membership is conditional: be it in terms of a minimum qualification to participate competently in the expert evaluation procedures or in terms of citizenship and elective franchise. While democratic government obtains its legitimacy through free, equal, and secret elections of representatives, which are mostly professional politicians, and jurisprudence relies on compliance with the law, court procedures, and the impartiality of judges, the scientific community insists on self-government in the form of self-regulation through peer-review procedures, i.e. organized skepticism.

Bearing in mind these organizing principles we can now imagine benchmarks that have to be taken into account when designing peer-review procedures with a view to their legitimation as a mechanism of self-government. A legitimate

execution of governance in decisions about scarce resources should align its procedures to ensure that it is (a) fair in the sense of impartiality, reflexivity, and acceptance of a plurality of paradigms, (b) reliably practical in the sense of functional efficiency as well as reactive and responsive in the way reviewer selection, composition of reviewing panels and evaluating commissions strive to enable ‘representative moments’ and strive for substantial interaction of both sides, and (c) responsible in the sense of accountability because the procedures are legible. In this way, peer review may assert itself as a mediator for moderating external and self-governance, thus managing the deep-rooted entanglement of science and politics in a democratically oriented societal environment.

11. Conclusion

We do not only claim that there are procedural similarities between peer review in science and democratic governance in society, but that these two are also intimately linked. While much of the literature conceptualizes peer review primarily with respect to its proximal outcomes (e.g. funding decisions), we gave equal weight to the practical process that leads to these decisions and to the scientific and political context in which peer review is practiced. From disaggregating peer-review processes into a combination of at least eight different activities, we were able to argue that a more encompassing definition of peer review is possible and desirable. The benefit of a broader definition of peer review lies not only in allowing for more comparative empirical studies, e.g. comparing journal and funding peer review, but also in rethinking how peer review works as an instrument of government. Our primary claim is, thus, that theoretical conceptions of peer review need to contend with two issues: First, peer review is not just a mechanism to decide on scarce resources in science, but also a procedure to assess quality based on expert judgement and an instrument for self-governance. Second, beyond self-governance, peer review is situated at the interface between science and policy and, as a consequence, provides not just decisions on the quality of scientific work but also provides the legitimacy for these decisions to be accepted within scientific communities and the wider public. We see these two issues as reflected in the aggregate of specific or common-sensical understandings in the empirical literature of what the role of peer review is. By aggregating these views, we hope to have provided the preliminaries to rethink and expand current theoretical discussions about peer review.

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Notes

1. None of these lists are meant to be exhaustive.
2. Recent exceptions are Forsberg et al. (2022) defining peer review as ‘a context-dependent, relational concept that is increasingly used to denote a vast number of evaluative activities engaged in by a wide variety of actors both inside and outside of academia’ (Forsberg et al. 2022: 4) and Eve et al. (2021) who define the role of peer review as ‘to institute a set of institutional practices that allow for the selection of quality by a group of empowered, qualified experts’ (Eve et al. 2021: 5). Horbach and Halffman (2018) limit their understanding of peer review to scientific publishing but not without mentioning that ‘so many forms of peer review exist that some claim we can no longer call it a single system’ (Horbach and Halffman (2018): 2). Also see Pontille and Torny (2015).
3. A recent series of three interrelated papers from the Research on Research Institute on innovations in peer review (Woods et al. 2023, Kaltenbrunner et al. 2022; Waltman et al. 2023) claim to use an ‘inclusive and broad interpretation’ (Woods et al. 2023: 2) of peer review but see little to no reason to justify limiting their ‘meta-summary’ and ‘analytical overview’ to journal peer review. Working with such a limited conceptualization even though addressing generalizable issues is taken for granted just as limiting the analysis to the ‘weaknesses of the peer review system’ is (Waltman et al. 2023: 2).
4. The historical study of peer review at the Royal Society Journals by Fyfe et al. (2020) conceptualizes peer review practices by ‘embedding journals within communities’ (Fyfe et al. (2020): 423) to generalize about how reviewing, journals and communities interrelate. These types of studies would benefit, in our view, from extending the definition of peer review because reviewing and communities are not just connected through journals, but also through funding and hiring.
5. For a dissenting view on determining the historical origins of peer review in line with the convention of the scientific revolution in the 17th century, see Rip (1985) or Laine and Mulrow (2003).
6. This echoes the symmetry principle in Bloor (1991).
7. Eve et al. (2021: 8) note that ‘much, although by no means all, of this research has been critical of peer-review processes’, but a quick count of the number of studies they mention in this context shows 4 with ‘positive opinions on the process’ and 35 as ‘critics of peer review’. While 90% of all empirical studies being rooted in the deficit model may be a high estimate, we see this as confirmation that a large majority is.
8. The sparse literature that works with a substantive theoretical approach will be reviewed in the next chapter.
9. These activities have been identified through empirical analyses of peer reviewing procedures in public research funding. They have been elaborated based on in-depth mixed-method analyses of different funding schemes, namely of the DFG in Germany and the SNSF in Switzerland, including single project funding, funding for collaborative research consortia, and career funding. For more detailed explanations, see (Schendzielorz and Reinhart 2020; Reinhart and Schendzielorz 2021).
10. These three types of legitimacy displace the formerly dominant types of ‘legitimacy as social recognition’ and ‘legitimacy as conformity to a norm’ (see Rosanvallón 2011: 7). The current three types are never indelibly achieved. Since they are ‘always open to challenge, and dependent on social perceptions of institutional actions and behavior’ (Rosanvallón 2011.) they operate as orienting principles that guideline our conception of democratic legitimacy.
11. To be responsible and to be made responsible as those who exercise power is to be subject to certain procedures of control that limit power. It is related to the possession of power and the possible consequence of those power control mechanisms to step back from it. Responsibility includes both accountability and an examination of capability a ‘test of ability’ (Rosanvallón 2018: 173), and is constitutive of public trust in those who govern. (Rosanvallón 2018: pp. 172–173). The former refers to the transparent documentation and presentation, justification, and assessment of

executive policy actions (Rosanvallón 2018: p. 183–186). The latter can be termed as ‘commitment’ (Rosanvallón 2018: p.186) and is directed toward the future and refers to the dimension of responsibility that is demonstrated by the extent to which those in power are able to make policy and thus demonstrate their will and ability to change existing states of affairs (Rosanvallón 2018: pp. 286–289).

12. In the case of responsiveness, Rosanvallón is concerned with the revival of social forms of expression in order to enable a ‘true democracy of expression and interaction’ (Rosanvallón 2018: 190). He diagnoses a decline in earlier forms of civic expression, such as intensive petitioning, which opened up a form of action for those excluded from the right to vote at the time, the labor unionized form of representation, and collective identities. Currently, the forms of expression that elicit responses from those in power have been reduced to the right to demonstrate, a narrow use of opinion polls as barometers of sentiment, and to atomized variants of expression on social networks. (Rosanvallón 2018: 196–202, 258–267) In order to increase responsiveness, he accordingly suggests the development of ‘altered forms of interaction between the governing and the governed’, for example, through the organization of representative moments in ‘ad hoc meetings’ (Rosanvallón 2018: p.203) and the establishment of a civil service or a ‘commission for democratic debates’ (Rosanvallón 2018: p. 205).

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