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Article

Research funding randomly allocated? A survey of scientists' views on peer review and lottery

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Abstract

The bold idea of random grant allocation is heatedly discussed as an alternative to peer review. The debate centers on advantages and disadvantages of the established measures to control scientific quality, compared to funding by chance. Recently, studies also investigated acceptance of lotteries in the scientific field. However, they provide only inconclusive findings due to their restricted scope. This paper examines scientists' views on current funding conditions and the idea of random grant distribution. An online survey of PhD holders reveals that most participants are against pure randomness, although they would try random elements if such procedures were combined with peer review. Moreover, while fewer established and recognized scientists differ in their assessments of peer review and expectancies on lotteries' impact, they hardly vary in their positions on random elements. Funding organizations therefore should be encouraged to further experiment with, and closely examine, practiced lotteries.

Key words: random grant allocation; lottery; peer review; survey; acceptance; scientific field.

In the second half of the 20th century, research funding substantially changed toward more competition, formal regulations, and project-based management (Serrano Velarde 2018; Whitley et al. 2018). At the same time, research expenses, numbers of scientists, and grant proposals, as well as requests for peer reviews, increased. This development led to decreased funding rates and increased pressure on reviewers to select fundable research. These circumstances can be problematic because while reviewers might have the best intentions, in conditions of indeterminacy, they also are liable to be influenced by prejudices, nepotism, cronyism, and the overrating of incremental research (e.g. Boudreau et al. 2016; Luukkonen 2012; Wenneras and Wold 1997). Against this background, various scholars (Avin 2015, 2019; Barnett 2016; de Peuter and Conix 2021; Gillies 2014; Guthrie et al. 2013; Greenberg 1998; Ioannidis 2011; Osterloh and Frey 2019; Roumbanis 2019a) introduced funding by lottery as an alternative to peer review. Later, this bold idea was turned into a set of discrete procedures with random elements (Bieri et al. 2021; Brezis 2007; Fang and Casadevall 2016) and is being applied in a growing number of funding programs (e.g. *Explorer grant* of the Health Research Council (HRC) in New Zealand, *Experiment! grant* of the Volkswagen Foundation in Germany, *1000 ideas grant* of the FWF in Austria, and in different funding initiatives of the Swiss National Science Foundation). In the academic debate, scholars argue that funding by lottery is impartial, unbiased, and cost efficient. Thus, it increases the chances of bold research ideas, less established researchers, and small laboratories being funded. They also, however, mention its blindness for merit and acknowledged scientific contributions, as well as its hampering effect on continuous research and skilled researchers' motivation.

Over the years, a growing number of contributors have taken part in a debate about the advantages and disadvantages of grant lotteries. They have turned a somewhat frivolous idea of allocating funding to well-conceived procedures that has gained more and more visibility. In that course, however, some scientists (e.g. Ackerley in Adam 2019; Beattie 2020; Vindin 2020) explicitly expressed their disagreement with this way of distribution in the highly regarded journal *Nature*. Ambrasat and Heger (2020) also recently disclosed in a large-scale survey that the overwhelming majority is opposed to pure grant lotteries. Smaller and program-specific surveys (Liu et al. 2020; Röbbecke and Simon 2020) also report disagreements with a widespread use of lotteries. Nonetheless, the program-specific studies and a qualitative investigation by Philipps (2021) indicate that under certain conditions, researchers sympathize with random elements. The findings suggest that scientists are more open to randomness if it is imbedded and tamed by peer review procedures. Considering these studies together, however, they provide only inconclusive evidence regarding the acceptance of random grant allocation in the scientific field. We know little about how scientists perceive different procedures of distributing funding combined with peer review and random elements. For example, do less established, compared to recognized scientists, differ in their perspectives? Do they favor or oppose different variants of lottery? What do they expect from funding by lottery?

This paper investigates scientists' views on current funding conditions and the idea of random grant distribution. We invited PhD-holding researchers to an online survey. All were employed at universities and extra-university research centers in the German federal state of Lower Saxony. The findings show that most participants reject using pure randomness to allocate financial resources for research. However, they would give random elements a try if such procedures were combined with established scientific measures to control quality. Thus, less established and recognized scientists differ in their assessments of peer review and expectancies on lotteries' impacts, but they hardly vary in their position toward random elements. These results might encourage funding organizations to further experiment with, and closely examine, practiced lotteries.

Before presenting current findings in more detail, the following section considers previous research on funding by lottery and provides a theoretical framework to investigate scientists' views on peer review and lottery procedures. Then, the current sampling and methodological approach will be reported, followed by results and what can be concluded from them.

1. An alternative to peer review

When Greenberg (1998) equated low funding rates with allocation by chance, it could have been read as a wake-up call to rethink the way research grants were distributed. Instead, it started an academic debate about lotteries as an alternative to peer review (Avin 2015, 2018, 2019; Barnett 2016; Brezis 2007; de Peuter and Conix 2021; Gillies 2014; Guthrie et al. 2013; Ioannidis 2011; Osterloh and Frey 2019, 2020; Roumbanis 2019a). As one of many established measures to assess scientific quality by peer scientists, peer review, of course, is a constitutional part of the scientific field. However, various studies (Bornmann and Daniel 2005; Bornmann 2011; Boudreau et al. 2016; Danthi et al. 2014; Fang et al. 2016; Luukkonen 2012; Roumbanis 2021) show that this procedure comes with some limitations. On the one hand, preparing proposals and applying for funding are stressful, time consuming, and conflicts with responsibilities for children and family (Herbert et al. 2014). On the other hand, if the number of requests for evaluations grows and funding quotas decrease, the pressure on reviewers to single out grant-worthy proposals increases. Most importantly, the reliability of peer review processes is questionable due to a low agreement rate and ambiguous scorings of the perceived quality of proposals (Brezis and Birukou 2020; Pier et al. 2018). It is especially challenging to identify potentially innovative ideas and to assess merit if assessments are based on metrics that count publications, citations, and received grants. Highly innovative researchers with low performances might have a hard time getting funding in contrast to some top-performing scientists who know how to play the game but who are not very original or innovative (Ayoubi et al. 2021). Moreover, if more applicants get training on how to write proposals (Roumbanis 2019b), this will lead to more grant-worthy applications. Reviewers will then be forced more often to distinguish between equally qualified proposals. Under such conditions of indeterminacy, it is no surprise that they value primarily incremental research and signs of scientific recognition (Boudreau et al. 2016; Chubin and Hackett 1990; Luukkonen 2012). These are common and widely accepted shortcuts to estimate research success. However, this approach also means that less recognized researchers and small laboratories have trouble receiving funding.

A lottery, in contrast, promises a selection process that is cost efficient, fair, unbiased, and capable of producing clear decisions (Elster 1989; Goodwin 2005; Stone 2009). Different scholars (Avin 2019; de Peuter and Conix 2021; Gillies 2014; Osterloh and Frey 2019; Roumbanis 2019a) argue that impartial treatment of applicants will increase the chance of unconventional research, as well as research by those who are less acknowledged. Supporters consider various methods of allocating funding by lottery. These methods differ both in their procedures and foci. Conceptually, Ioannidis (2011), for example, proposed to fund people by lottery, not projects. Brezis (2007) suggested a so-called 'focal randomization' for proposals with disagreeing reviews. Fang and Casadevall (2016), in contrast, proposed to select among the best applications. In the case of the Volkswagen Foundation in Germany and New Zealand, at both its HRC and in its Science for Technological Innovation initiative, they have opted to apply lotteries. These programs start with a rigorous scientific evaluation of the proposals and only applications eligible for funding find their way into a lottery draw (see Avin 2019). The Swiss National Science Foundation makes use of a lottery as a 'tie-breaker' for all their grant schemes (see Chawla 2021).

In the last decade, these proposed procedures were accompanied by simulations and field experiments with random grant allocation. Avin (2015, 2018) modeled distinct ways to finance research—including randomized proposal selection—and showed that a lottery would increase research's diversity in the long term. Gross and Bergstrom (2019) ran a simulation indicating that if resources are restricted, a lottery would be more efficient to finance all worthy applications than other procedures. Bieri et al. (2021) showed that reviewers would more often use a lottery if peer review procedures were simplified. In addition, Höylä et al. (2016) calculated in a simulation how funding by lot affects researchers' motivations. Their results indicate that less-skilled scientists would have a better chance, but skilled scientists would get frustrated and turn away from science.

Recently, scholars also began to examine the acceptance of random grant allocation. After some scientists voiced their disagreements, Ambrasat and Heger (2020) placed a thematically related question in the DZHW Scientists Survey in 2019. They asked 4,436 scientists whether they would support random distribution of funding if proposals are formally correct. A clear majority of 69 per cent of the participants rejected such a procedure. Professors and those in lower academic positions did not differ in their disapproval. A random distribution of all sorts of grant types was also viewed with suspicion in a survey among applicants for the *Explorer Grant* of the HRC (Liu et al. 2020). Interestingly, although, 63 per cent (79 out of 126) accepted the random element in this particular funding program. They sympathized with randomness if it is placed at the end of a systematic evaluation of transformative research proposals. Röbbecke and Simon (2020) reported similar findings in their online survey of 25 scientists who received funding from the German Volkswagen Foundation. Participants mainly supported lottery, which is part of the selection process to finance unconventional research. Their study also highlighted that those who were granted funding believe in the lottery and its effect on fairness, thematic diversity, and the chance of high-risk research being funded. Based on 32 qualitative interviews, Philipps (2021) revealed that scientists primarily trust in scientific quality insurance measures, such as peer review. Nonetheless, they would give lotteries a try for different reasons. These interview statements indicated that less established researchers hope for more chances for minorities and high-risk research. Recognized scientists who are familiar with evaluation panels sympathized with lotteries if they could be used to shorten prolonged, frustrating assessment processes.

Overall, these findings suggest that scientists differ in their views on variants of lottery and reasons to apply random elements. However, Ambrasat and Heger (2020) only asked to rate a relatively all-inclusive lottery model, whereas more differentiated approaches (in Liu et al. 2020; Röbbecke and Simon 2020) were presented to applicants of the *Explorer* and *Experiment!* funding programs. Philipps (2021) admittedly included a greater variety of scientists with different academic statuses and experiences, but his sample only comprises 32 participants. Hence, it is still an open question what scientists with different backgrounds think about distinct lottery procedures, and whether they have distinct expectations and hopes, which should be considered in further applications of random elements to distribute research funding.

2. Theoretical framework

When arguing in favor of lotteries, scholars mainly attempt to overcome indeterminacy (Duxbury 1999; Elster 1989; Stone 2009) or warrant justice and diversity (Buchstein 2019; Engelstad 1989; Goodwin 2005). For science and the allocation of research funding, they recurrently emphasize impartiality and diversity (de Peuter and Conix 2021; Gillies 2014; Osterloh and Frey 2019; Roumbanis 2019a). Lotteries are often introduced to make science just and to broaden the spectrum of scientific approaches. Interestingly, justice in general is usually not an imperative of science. Rather, gaining scientific knowledge is related to reasoning based on theories and methods. According to social scientists like Merton (1942), Polanyi (1962), and Bourdieu (1990, 2004), scientists expect that theoretically convincing and empirically grounded arguments will triumph over less substantial arguments and findings. Further, they commonly believe that researchers receive acknowledgement for their findings and discoveries and thus become recognized scientists in their fields. In the world of science, merit finally pays off in getting academic positions and having research funded. Consequentially, recognized scientists shape current research directions and get more out of existing structures than less established researchers (Matthew effect). However, dysfunctional and obstructive conditions of the scientific field are mainly discussed if: circumstances in the political or economic fields undermine the autonomy and standards of science (Bourdieu 2004; Whitley et al. 2018); researchers manipulate their data and fudge their findings to gain reputation (Chubin 1985; Kumar 2008; Schachman 1993); or, if scientifically pivotal procedures like peer review disadvantage certain groups of researchers and approaches (Ginther et al. 2016; Kaatz et al. 2015; Tabak and Collins 2011; Wenneras and Wold 1997). Such malfunctions are not mentioned to tear down the inherent meritocratic order of the scientific field. Rather, they are brought into light to uphold scientific principles.

Randomness, as mentioned above, is mainly proposed to increase fairness and diversity in peer review processes. Scholars like Gillies (2014), Osterloh and Frey (2019, 2020), as well as Roumbanis (2019a), argue that evaluations by peer scientists disadvantage both less established researchers and unconventional approaches. Further, they assume that this procedure attracts applicants to concentrate on proven theories and methods, and on topics of general interest. Randomly selected research proposals and articles, they reason, facilitate the pursuit of fresh impulses because it finances and publishes more exceptional ideas, compared to traditional approaches. In short, it all seems to be about fairness because this way of choosing is blind to differences. On inspection, supporters of random allocation are hardly concerned with social justice in general terms. They rather aim to improve conditions such that research can generate new scientific knowledge and break out of established approaches. A potential negative consequence is that randomly distributed grants might also affect positions in the scientific field. Particularly, as various authors (Avin 2019; Gillies 2014; Höylä et al. 2016) suggest, lotteries increase the chances of the less-skilled and frustrate skilled scientists. In a meritocratically organized scientific field, randomness thus can improve expectations, as well as lowering the morale of its actors.

Bourdieu's accounts on the scientific field (1990, 2004) provide a theoretical framework to consider science's functional and structural specifics. In his field theory, he conceptualizes rules and procedures of the scientific field as being historically constituted to produce new knowledge and give credit (reputation) to successful researchers. However, the field's structure is not static and universal. Rather, researchers struggle and debate about how scientific and institutional capital is distributed. Field positions differ with changing amounts of scientific and institutional capital. With growing capital, scientists gain power and opportunities to benefit from the scientific field and its established rules and procedures. Getting a professorship, for example, means a gain in institutional capital because such a position empowers one to control scientific careers within the affiliated academic institution. However, a professorship does not necessarily impart great recognition in the scientific community. Recognition is related to accumulated scientific capital gained through academic achievement (e.g. prices) as well as highly visible and cited publications. Hence, accumulated capital in the scientific field is not only a signifier of success but also gives access to powerful field positions that enable holders to determine and control scientific institutions, rules, and procedures. In short, recognized scientists in such positions dominate and regulate the scientific field to their ends, whereas less recognized researchers (e.g. novices, less established) must comply with existing field-specific structures to advance.

Based on observations in previous research (Philipps 2021) and Bourdieu (1990, 2004) theoretical framework, one can assume that the imbalanced power distribution in the scientific field affects scientists' views on field-specific procedures and funding by lot. Highly acknowledged researchers who are equipped with scientific and institutional capital can efficiently master the science game and profit from existing field-specific rules and procedures. Less established scientists (with little scientific and institutional capital), in contrast, struggle to receive funding and get published. They might feel that the current structure of the scientific field is against them and that modifications could bring welcome change. More precisely, one can propose that less established, in contrast to recognized, scientists are more skeptical regarding established scientific procedures to assess research ideas and allocate funding. This study tests the following hypothesis (H) on the relationship between the status of researchers and their viewpoint on funding and peer review processes:

H1: Less established, compared to recognized, scientists more often perceive problems with funding and peer review procedures.

If recognized researchers are successful in the scientific game (Bourdieu 1990, 2004), one can further assume that they will be less open to changes in the scientific field (including funding by lot). The less established, in contrast, should favor alterations that, from their point of view, will modify given structures to their ends. The latter should be in favor of lottery since it promises an impact. Reformulated and tested in:

H2: Less established, compared to recognized, scientists more often support funding by lot.

Furthermore, statements in qualitative interviews (Philipps 2021) suggest that scientists who serve on grant review panels complain about hasty decisions being made toward the end of panel sessions, which might increase their preference for lottery. In the same study, it is also evident that less recognized scientists are more critical of existing scientific rules and regulations, are open to adaptation, and have higher expectations of selection procedures that include elements of randomness. If they assume that currently used peer review procedures decrease their chances to advance in the scientific field, they might overemphasize its impartiality. Recognized scientists, in contrast, should be more skeptical. This claim will be tested in this hypothesis:

H3: Less established, compared to recognized, scientists more often agree that a lottery will improve funding conditions for researchers.

However, various commentaries and empirical studies (see above) indicate that scientists in a variety of academic positions are skeptical toward funding by lot in general and that they would reject such an alternative to peer review. Philipps (2021) also revealed that both less established and highly established researchers who deliberate about random grant allocation defend scientific norms and rules on how to do reasonable science. This might indicate strong reservations against all forms of distribution by lottery. Against this background, it is also reasonable that less established and recognized scientists hardly differ in their views.

3. Data and method

To investigate scientists' views on randomly allocated research grants an e-mail was send to 2,150 scientists who are qualified to apply for funding and affiliated with an university or extra-university research center in the German federal state of Lower Saxony. The main unit includes all employed scientists with a PhD and an entry on the websites of selected academic institutions. In autumn of 2020, e-mail addresses were retrieved from departments related to research fields such as biology, physics, chemistry, production engineering, electrical engineering, computer science, and history. These scientists were invited to complete an anonymous online survey via LimeSurvey[1] in January and February 2021. The survey was open for 6 weeks and a reminder was sent after 3 weeks.

Based on previously conducted qualitative interviews about the subject (Philipps 2021), the author developed the survey questions. The online questionnaire comprised 15 closed-ended questions, including inquiries on the perceived funding situation in Germany; the functionality of peer review procedures; effects of randomness on the allocation of funding; and questions about the participants' gender, affiliation, research field, academic status, and involvement in peer review processes. It should be noted that we transferred recurringly mentioned observations and assumptions about peer review and lottery in the interviews to the survey (see Appendix A) to check what other scientists think about this issue. Additionally, we amplified these propositions about the perceived funding situation and functionality of peer review. We did not ask whether participants observed any malfunctions. Rather, participating scientists had to state if a 'majority' is doing certain phenomena (e.g. funding organizations stipulate research topics or reviewers rate research projects with preliminary work higher than those without).

Two hundred eighty-three scientists (13.2 per cent) responded to the e-mail and started with the online survey. Fifty-nine participants only answered questions in the first half of the survey. In total, 224 questionnaires were completed (including information about their participation in grant juries). Two reasons can explain non-responses to some extent. First, Philipps (2021) observed in his qualitative interviews that funding by lot hardly concerns scientists. It seems that for most researchers, the subject has a low priority. Second, the questionnaire was only sent out in German, which excluded the non-German speakers in the selected academic institutions.

The sample of 283 comprises 59 woman, 160 men, and five who selected 'others'. Most of them were affiliated with universities ($n = 153$, including universities of applied sciences), a small group were affiliated with extra-university research centers ($n = 44$), and in 27 cases, they worked in both types of academic institutions. Regarding research fields (using categories of the German Research Council, DFG), participants associated themselves with biology ($n = 51$), physics ($n = 36$), chemistry ($n = 32$), informatics, system and electrical engineering ($n = 37$), production engineering ($n = 25$), medicine ($n = 16$), history ($n = 19$), and eight contributors constitute the category 'others,' including psychology, environmental studies, geological science, radiological science, didactics, and statistics. Regarding academic positions, there were 99 professors and 125 research assistants. If one considers that most academic positions below professorship are temporary contracts in Germany, a remarkable proportion of scientists who completed the survey had permanent positions ($n = 153$). Finally, most participating scientists had already written a review ($n = 217$), but only 24 had also been part of a panel that selected candidates for prices. Eighty-nine had previously decided on research grants in review panels.

This study concentrates on different positions in the scientific field and related perspectives on randomly distributed funding. Academic status is not necessarily a signifier of substantial institutional and scientific capital. Being invited to partake in evaluation panels, however, is a well-documented indicator of high recognition in the scientific field and beyond (Lamont 2009; Musselin 2013; Whitley and Gläser 2007). Hence, we differentiated between scientists who have experience with and effectively decide on grant distributions and those who do not. The latter group, of course, managed to pursue a scientific career and earned scientific and institutional capital, but they are not in positions to decide on funding and implicitly on research direction in the scientific field. Finally, this study compares the views of less established scientists with those who are recognized (marked by partaking in evaluation panels).

This investigation used cross table and chi square (χ^2) calculations in SPSS for the statistical analysis. The test checked if the observed frequencies of the two categorical variables matched the expected frequencies within a 95 per cent confidence interval. Cramer V informs about the degree of relation between the two variables from weak (<0.1) to strong (>0.5). In addition, one should note that all items in the questionnaire were rated on a five-point Likert-scale ranging from 'strongly agree' to 'strongly disagree.' This scale allowed survey participants to make clear assessments, as well as weak suggestions, such as 'tend to agree/disagree' and 'neither/nor.' The latter in particular might also be marked if they felt unable to answer at all. However, a limiting factor was that for some questions there are very small numbers for the extreme positions. Therefore, 'strongly agree,' and 'tend to agree' were merged, as were 'strongly disagree' and 'tend to disagree'. As such, in this paper all findings were grouped into 'agree,' 'undecided,' and 'disagree.'

4. Results

4.1 Views on research funding and peer review

First, participants were asked to qualify the research funding situation in Germany. In this regard, Fig. 1[2] shows that almost everyone in the survey observes high pressures to receive competitive grants (95 per cent). Almost 2/3 of all participants also reported increasing numbers of review requests (65 per cent) and even more criticized non-transparent processes to select reviewers (69 per cent). Further, a great majority stated that funding organizations often provide no constructive feedback on proposals (58 per cent) and that they direct research thematically (56 per cent). Smaller, but still huge majorities said that very low funding rates come close to a distribution by chance (46 per cent) and that funding organizations tolerate decisions, to a growing extent, based on non-scientific criteria (37 per cent). In sum, participants were very critical of the current circumstances for financing research.

Remarkably, recognized scientists mostly agreed with these judgements (see Table 1). They only agreed to a significantly lesser extent in three aspects. From their point of view, fewer assumed that the choice of reviewers is opaque (57 per cent vs. 74 per cent) and that funding organizations give insufficient responses (45 per cent vs. 63 per cent). Corresponding with their insider knowledge concerning peer review processes, they more often recognized increasing requests for reviews (76 per cent vs. 61 per cent).

Second, peer review, as a measure of scientific quality control, by scientists in the same research field was highly appreciated. In Fig. 2, 86 per cent of all participants believed that peer review secures scientific standards. However, 89 per cent assumed that in proposal assessments, reviewers favor research ideas that are based on previous investigations. This provides the ground to predict research success, in contrast to high-risk research, which is believed to have less chance in peer review procedures. A great proportion of participants also said that reviewers favor applicants they

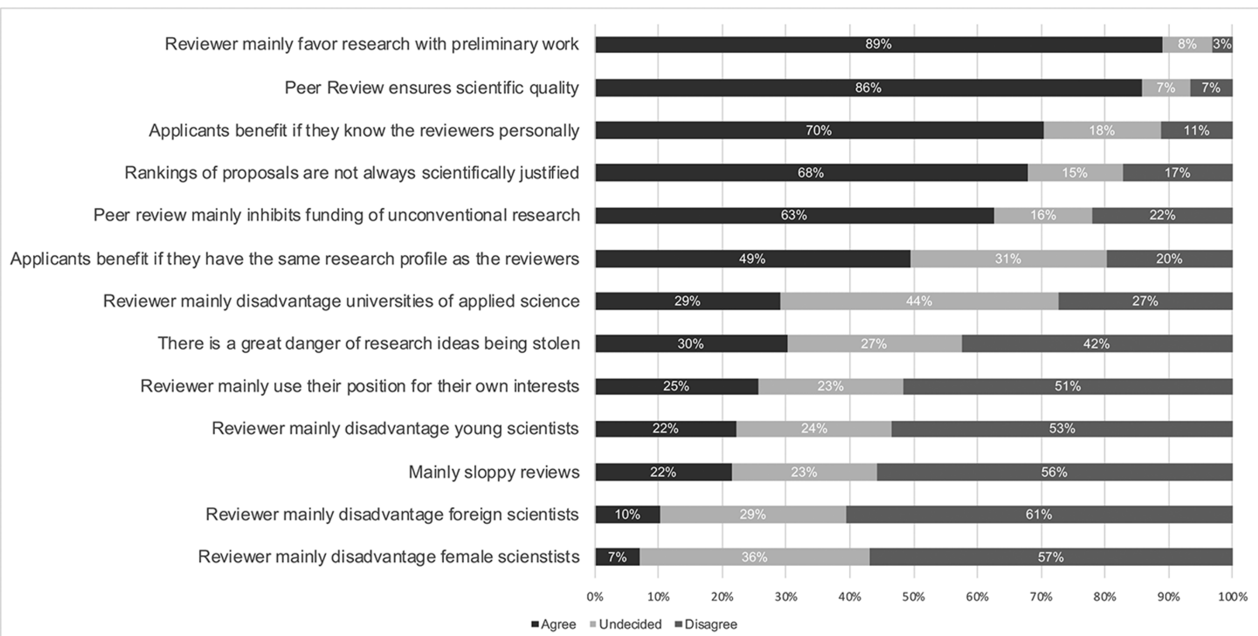

Figure 1. Scientists' views on the current grant distribution in Germany.

Table 1. Group-specific views on grant distribution.

	Total	Less established scientists			Recognized scientists				
		Agree	Undecided	Disagree	Agree	Undecided	Disagree	*P*-value	Cramer V
Increased competition for third-party funding	223	127 (94%)	5 (4%)	3 (2%)	84 (95%)	3 (3%)	1 (1%)	–	–
Selection of reviewers is non-transparent	223	100 (74%)	28 (21%)	7 (5%)	50 (57%)	21 (24%)	17 (19%)	0.002**	0.237
DFG operates toward scientific standards	221	92 (69%)	24 (18%)	18 (13%)	71 (82%)	7 (8%)	9 (10%)	0.072	0.154
Funding organization mainly provide no feedback	223	85 (63%)	27 (20%)	23 (17%)	40 (45%)	25 (28%)	23 (26%)	0.036*	0.173
Too many requests for reviews	222	83 (61%)	37 (27%)	15 (11%)	66 (76%)	19 (22%)	2 (2%)	0.022*	0.186
Funding organization mainly steer research thematically	223	78 (58%)	37 (27%)	20 (15%)	48 (55%)	26 (30%)	14 (16%)	0.893	0.032
Due to low funding rates distribution is random	222	59 (44%)	28 (21%)	47 (35%)	44 (50%)	10 (11%)	34 (39%)	0.182	0.124
Funding organization mainly tolerate non-scientific criteria	222	51 (38%)	44 (33%)	39 (29%)	30 (34%)	24 (27%)	34 (39%)	0.327	0.100

* $P < 0.05$, ** $P < 0.01$, two-tailed.

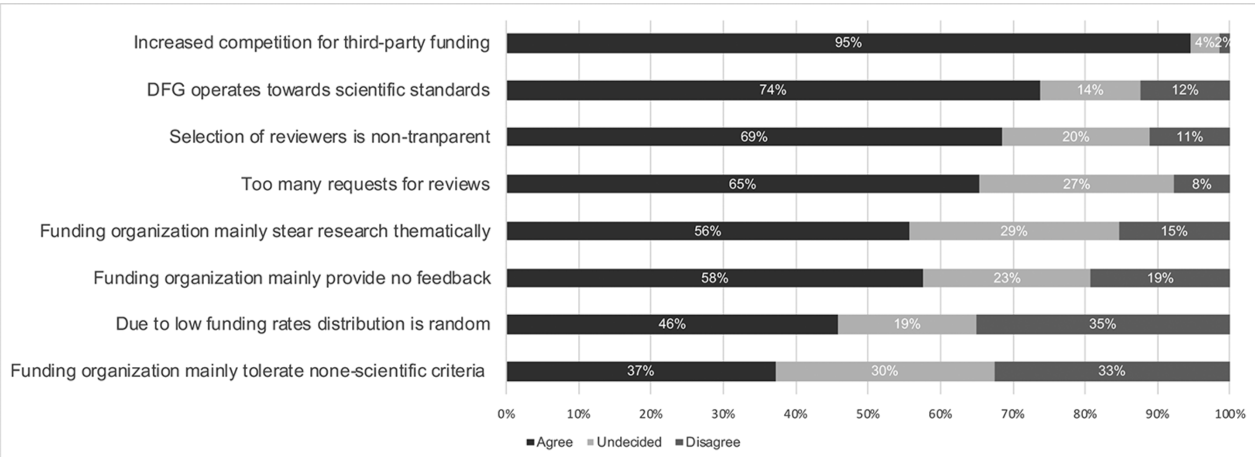

Figure 2. Scientists' views on peer review.

personally know from their own networks (70 per cent), and that the fine-tuning of rankings of applications is not always scientifically justified (68 per cent). To a lesser extent, participants assumed that proposals in the reviewers' field of research have better chances (49 per cent), or they opposed the proposition that reviewers steal research ideas (42 per cent). Most participants also disagreed with statements suggesting that peer review procedures disadvantage women (61 per cent), foreign researchers (57 per cent), and young scientists (53 per cent). They further mainly disagreed that reviewers write sloppy evaluations (56 per cent) and pursue their own interests (51 per cent). However, one should also note that almost one quarter of all participating scientists expected that reviewers mainly act on self-interest, disadvantaging young scientists, and provide superficial comments. Almost one third (30 per cent) of them even assumed that intellectual theft often occurs. Regarding women, every tenth participating scientist presumed that reviewers disadvantage female participants. Interestingly, among the female participants this proportion rose to 25 per cent. Finally, there was no clear position in the case of participants from a university of applied sciences on their chances in research assessments. This might be explained by the small number of survey participants ($n = 21$) who are affiliated with such academic institutions and the lack of knowledge and experience among other participants with the success rates of this special group.

Further analyses (see Table 2) showed that scientists who take part in evaluation panels were less skeptical about the functionality of peer review processes. A smaller share of recognized scientists compared to less established scientists agreed significantly with statements about prevailing nepotism (56 per cent vs. 77 per cent) and difficulties with the ranking of research proposals (60 per cent vs. 73 per cent). They also clearly dismissed suggestions that peer review disadvantages women (79 per cent vs. 47 per cent), foreign researchers (76 per cent vs. 44 per cent), and young scientists (75 per cent vs. 39 per cent). A greater proportion of this group also rejected statements suggesting that reviews are mostly superficial (65 per cent vs. 50 per cent), that reviewers pursue their own interests (66 per cent vs. 45 per cent), and that they become intellectual thieves (54 per cent vs. 36 per cent).

In general, recognized scientists who participated in this survey were frequently more uncompromised in their answers. First, portions of those who selected 'undecided'

Table 2. Group-specific views on peer review.

	Total	Less established scientists			Recognized scientists				
		Agree	Undecided	Disagree	Agree	Undecided	Disagree	*P*-value	Cramer V
Peer review ensures scientific quality	224	119 (88%)	8 (6%)	8 (6%)	77 (87%)	5 (6%)	7 (8%)	0.849	0.038
Reviewer mainly favor research with preliminary work	224	119 (88%)	12 (9%)	4 (3%)	84 (94%)	4 (4%)	1 (1%)	–	–
Applicants benefit if they know the reviewers personally	224	104 (77%)	19 (14%)	12 (9%)	50 (56%)	23 (26%)	16 (18%)	0.004**	0.221
Rankings of proposals are not always scientifically justified	224	99 (73%)	20 (15%)	16 (12%)	53 (60%)	13 (15%)	23 (26%)	0.023*	0.183
Peer review mainly inhibits funding of unconventional research	224	84 (62%)	19 (14%)	32 (24%)	55 (62%)	10 (11%)	24 (27%)	0.754	0.050
Applicants benefit if they have the same research profile as the reviewers	224	61 (45%)	46 (34%)	28 (21%)	50 (56%)	25 (28%)	14 (16%)	0.268	0.108
Reviewer mainly disadvantage universities of applied science	221	31 (23%)	70 (53%)	31 (23%)	25 (28%)	31 (35%)	33 (37%)	0.021*	0.187
Mainly sloppy reviews	224	27 (20%)	40 (30%)	68 (50%)	18 (20%)	13 (15%)	58 (65%)	0.027*	0.179
Reviewer mainly disadvantage female scientists	224	22 (16%)	50 (37%)	63 (47%)	3 (3%)	16 (18%)	70 (79%)	0.000***	0.327
Reviewer mainly disadvantage foreign scientists	224	15 (11%)	60 (44%)	60 (44%)	1 (1%)	20 (22%)	68 (76%)	0.000***	0.330
Reviewer mainly use their position for their own interests	222	38 (28%)	36 (27%)	61 (45%)	15 (17%)	15 (17%)	57 (66%)	0.012*	0.199
Reviewer mainly disadvantage young scientists	224	39 (29%)	43 (32%)	53 (39%)	9 (10%)	13 (15%)	67 (75%)	0.000***	0.355
There is a great danger of research ideas being stolen	224	43 (32%)	43 (32%)	49 (36%)	22 (25%)	19 (21%)	48 (54%)	0.031*	0.176

$^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$, two-tailed.

are recurrently smaller compared to the group of less established scientists. Second, more recognized scientists rejected suggested forms of disadvantages and illegitimate behavior in peer review processes. However, they were frequently less convinced that old-boys' networks and the ranking of equally grant-worthy proposals are problematic. These findings support hypothesis H1, which predicted that more recognized, compared to less established, scientists see fewer problems with peer review procedures. From their point of view, existing quality control measures work toward scientific means. Thus, it seems to support an observation made in a previous study (Philipps 2021) that less recognized researchers are more open to alternatives to existing peer review procedures.

Nonetheless, recognized and less established scientists shared observations that peer scientists tend to give funding to research ideas that build on previous investigations, rather than to unconventional, unpredictable approaches. In other words, they believe that the practiced organized skepticism is inherently conservative. In addition, they agreed with propositions regarding increased review requests and pressures due to competitive grant distribution. Interestingly, these are recurring arguments *against* peer review and *in favor* of randomly distributed funding. In this line of argumentation, lotteries lower the burden of evaluation and produce more diversity through increased chances for unconventional research. Random allocation of funding hence might be an option to solve certain problems in the scientific field for both less established and recognized scientists (see also Barlösius and Philipps 2020).

4.2 Views on different lottery models to allocate funding

Differences between the groups of scientists regarding the functionality of peer review are also evident concerning the variants of randomly distributed research grants. Like Ambrasat and Heger (2020) have shown, for a relatively all-inclusive approach of a lottery for formally correct applications, a great majority of survey participants rejected this procedure (see in Fig. 3 Procedure A). While both authors hardly found differences between scientists with a professorship and those without, in our sample, recognized researchers (76 per cent, see Table 3) tend to oppose this variant of funding by lottery more frequently than less established scientists (61 per cent). However, this opposition turns into an approval when participants agree on procedure B, which combines established scientific measures of peer review with random elements (see Fig. 3 and Table 3). Under this circumstance, a greater share of less established scientists (64 per cent) showed sympathy for a scientifically driven lottery than did recognized researchers (52 per cent). This gap vanished completely when they rated procedure C, which comprises a random selection process after a board of scientific reviewers has evaluated research proposals. In total, 61 per cent and more of both groups of scientists would allow random elements if tamed by this kind of scientific quality control measure. In sum, less established scientists tend to be more open to probing modified lotteries, but altogether, observed differences were not statistically significant. Thus, hypothesis H2 was rejected because it appeared that both groups imagine

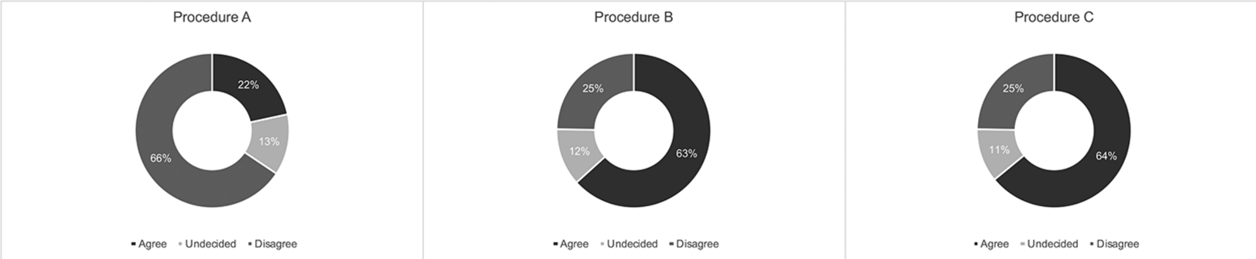

Figure 3. Scientists' views on lottery models. In Procedure A, all formally correct proposals are drawn by lottery. Procedure B combines peer review of formally correct proposals with a lottery. In Procedure C, formally correct proposals are assessed by a scientific panel before being selected for a lottery.

Table 3. Group-specific views on lottery models.

		Less established scientists			Recognized scientists				
	Total	Agree	Undecided	Disagree	Agree	Undecided	Disagree	*P*-value	Cramer V
Procedure A	224	31 (23%)	21 (16%)	83 (61%)	13 (15%)	8 (9%)	68 (76%)	0.065	0.156
Procedure B	224	87 (64%)	17 (13%)	31 (23%)	46 (52%)	12 (13%)	31 (35%)	0.120	0.137
Procedure C	224	83 (61%)	14 (10%)	38 (28%)	55 (62%)	10 (11%)	24 (27%)	0.968	0.017

Two-tailed.

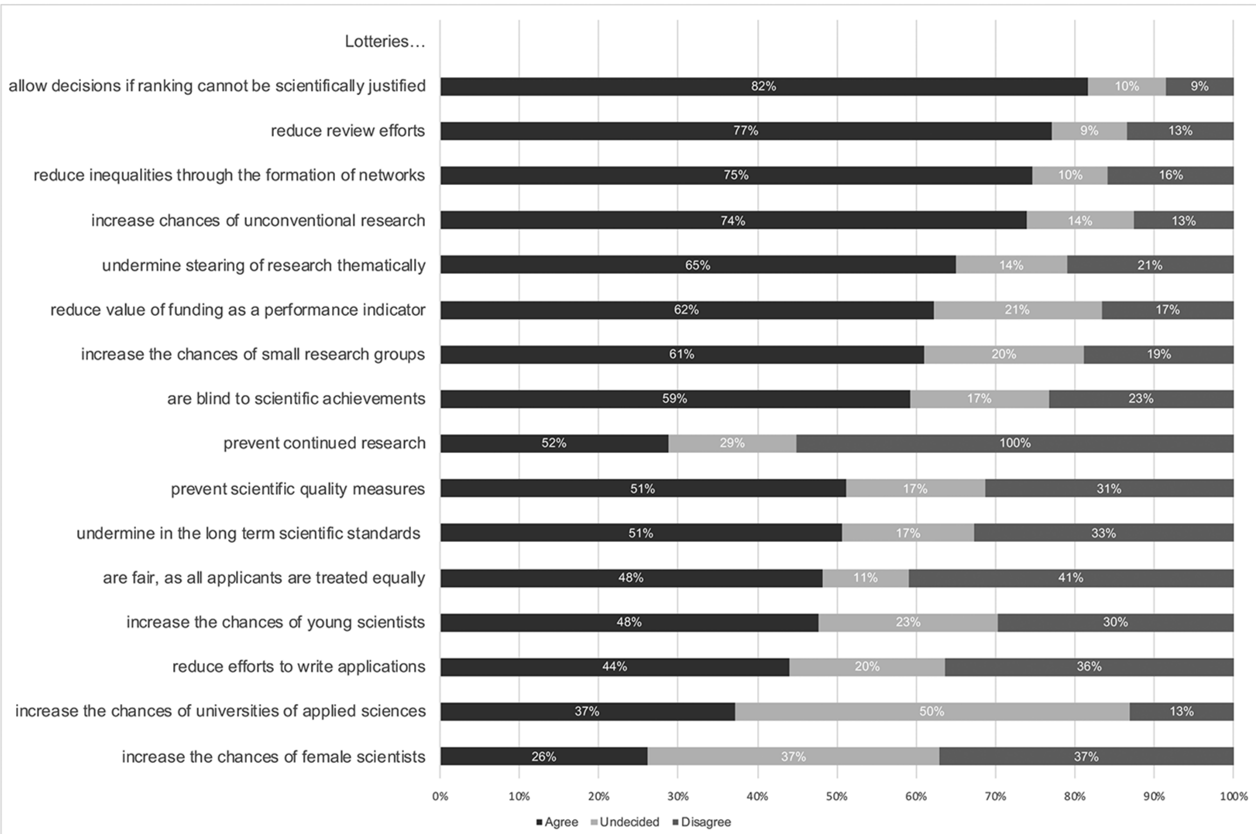

Figure 4. Scientists' view on randomness and its effect on science.

certain pressing contexts and circumstances that seem to call for random selection as an additional way to allocate funding.

4.3 View on lottery and its impact on the scientific field

Going on to expected impacts of lotteries on the scientific fields, our survey revealed that most participants assume science will be affected by random grant distribution (see Fig. 4). In this respect, it is interesting to observe that less established, as well as recognized, scientists mainly tend to agree and disagree in the same direction (see Table 4). As presented in Fig. 4, an overwhelming majority expects that randomization could overcome ambiguous decision-making processes in case of equally qualified proposals (82 per cent), decrease efforts to assess research proposals (77 per cent),

Table 4. Group-specific view on randomness and its effect on science.

	Total	Less established scientists			Recognized scientists			*P*-value	Cramer V
		Agree	Undecided	Disagree	Agree	Undecided	Disagree		
Lotteries …									
Allow decisions if ranking cannot be scientifically justified	223	111 (83%)	15 (11%)	8 (6%)	71 (80%)	7 (8%)	11 (12%)	0.199	0.120
Reduce inequalities through the formation of networks	221	104 (78%)	12 (9%)	17 (13%)	61 (69%)	9 (10%)	18 (20%)	0.271	0.109
Reduce review efforts	223	104 (78%)	13 (10%)	17 (13%)	68 (76%)	8 (9%)	13 (15%)	0.911	0.029
Increase chances of unconventional research	222	97 (73%)	20 (15%)	16 (12%)	67 (75%)	10 (11%)	12 (13%)	0.705	0.056
Prevent steering of research thematically	223	93 (69%)	16 (12%)	25 (19%)	52 (58%)	15 (17%)	22 (25%)	0.240	0.113
Reduce value of funding as a performance indicator	222	85 (64%)	28 (21%)	20 (15%)	53 (60%)	19 (21%)	17 (19%)	0.707	0.056
Increase the chances of small research groups	223	85 (63%)	24 (18%)	25 (19%)	51 (57%)	21 (24%)	17 (19%)	0.551	0.073
Are blind to scientific achievements	223	77 (57%)	28 (21%)	29 (22%)	55 (62%)	11 (12%)	23 (26%)	0.246	0.112
Are fair, as all applicants are treated equally	222	75 (56%)	10 (8%)	48 (36%)	32 (36%)	14 (16%)	43 (48%)	0.007**	0.211
Increase the chances of young scientists	222	71 (53%)	30 (22%)	33 (25%)	35 (40%)	20 (23%)	33 (38%)	0.086	0.149
Prevent continued research	222	68 (51%)	41 (31%)	25 (19%)	48 (55%)	24 (27%)	16 (18%)	0.838	0.040
Prevent scientific quality measures	223	65 (49%)	27 (20%)	42 (31%)	49 (55%)	12 (13%)	28 (31%)	0.405	0.090
Reduce efforts to write applications	220	61 (47%)	28 (21%)	42 (32%)	36 (40%)	15 (17%)	38 (43%)	0.266	0.110
Undermine in the long term scientific standards	223	58 (43%)	27 (20%)	49 (37%)	55 (62%)	10 (11%)	24 (27%)	0.021*	0.186
Increase the chances of universities of applied sciences	221	55 (41%)	62 (47%)	16 (12%)	27 (31%)	48 (55%)	13 (15%)	0.237	0.108
Increase the chances of female scientists	221	44 (33%)	44 (33%)	45 (34%)	14 (16%)	37 (42%)	37 (42%)	0.018*	0.191

*$P < 0.05$, ** $P < 0.01$, two-tailed.

circumvent old-boys' networks (75 per cent), and increase the chance of unconventional research (74 per cent). They also agreed with propositions that propose funding organizations would have less power to adjust research directions due to lotteries (65 per cent), and that evaluators can less rely on performance indicators, such as earned amount of funding (62 per cent).

However, they tend toward different directions on statements regarding justice (see Table 4). A greater share of less established, compared to recognized, scientists expected that random allocation of grants would reduce efforts to write proposals (47 per cent vs. 40 per cent) and would be fair (56 per cent vs. 36 per cent). They also assumed that certain groups, such as women (33 per cent vs. 16 per cent), small research teams (63 per cent vs. 57 per cent), and young researchers (53 per cent vs. 40 per cent) will profit from lotteries. However, these differences were only statistically significant for statements on fairness and increased chances for women. Greater proportions of recognized scientists, in contrast, issued that an application of lotteries will undermine scientific quality measures, continued research, meritocracy of science, and scientific standards in the long term. More of them were significantly skeptical regarding the overall impact of lottery on the scientific field and its rules and conventions (62 per cent vs. 43 per cent).

In sum, less established and recognized scientists differ in their views on funding by lottery. The former tend to hope that lottery would make science more just. The latter, in contrast, anticipate more degrading effects and are less concerned with impartial distributions. However, these differences are not statistically significant for most propositions and only weakly related in the case of rather bold statements on the assumed effects. Regarding lotteries, less established researchers expected more fairness (especially for women) and recognized one predicted negative impact on science in general. In all other aspects they do not statistically differ. Consequently, the overall assumption of H3 was rejected.

5. Discussion and conclusion

This paper investigated views of scientists on peer review and random grant allocation related to different field positions. Based on Bourdieu's field theory, it was postulated that highly acknowledged scientists dominate their research field if they partake in review panels and decide on research funding. They profit from existing structures and regulations of the scientific field and therefore, compared to less established researchers, they are less concerned with dysfunctional peer review and less open to lottery procedures. Previous empirical studies (Ambrasat and Heger 2020; Liu et al. 2020;

Röbbecke and Simon 2020) support these assumptions. They report on supporters and rejecters of randomly distributed grants, which suggests distinct perspectives and hopes regarding randomness. Nonetheless, due to restricted survey scopes of earlier investigations, these findings are insufficient to justify the deepening of efforts to improve peer review processes and implement alternatives.

The results of this survey with 283 scientists show that less established researchers tend to be frequently more worried about practices of peer review and conditions for distributing funding. Recognized scientists are also concerned in certain respects (e.g. dropping funding rates, growing pressures to receive financial resources, more requests for reviews), but not to the same degree. The groups differ significantly on statements about non-transparent choices of reviewers, insufficient feedback on funding decisions, as well as assertions that reviewers become intellectual thieves or that they disadvantage female, young, and foreign researchers. Particularly, the highly significant differences in assessments of propositions about social disadvantages indicate that in the view of dominated field actors, the scientific field is structured primarily by social categories and less by merit. In sum, less established, compared to recognized, researchers perceive more dysfunctional elements in peer review processes. Interestingly, less established researchers more frequently expect balancing effects of random elements on fairness and diversity in the scientific field. Scientists who decide on research funding in review panels, in contrast, are more skeptical and more often assume a destructive impact on scientific standards and measures to control quality. However, in line with previous surveys (Ambrasat and Heger 2020; Liu et al. 2020; Röbbecke and Simon 2020), participants of this survey rejected pure randomness, but not modified variants of lottery, to distribute research grants. Great proportions of both groups would try out lottery procedures if combined with established measurements to evaluate scientific ideas and outcomes.

These findings are a ticket for officers of funding organizations and representatives of science policy to continue—and even to intensify—experiments with random elements in procedures to allocate research grants. They do not, however, justify replacing peer review processes. Rather, the results indicate an openness for lottery as a corrective element for certain purposes and occasions. Together with scientists' concerns asserted in in-depth interviews (Barlösius and Philipps 2020; Philipps 2021), this survey indicates that scientists would broadly consider using randomness to select proposals if they are equally grant-worthy, if networks of scientists affect decision-making processes, or if unconventional approaches are systematically excluded. Less recognized researchers in the sample also expect that using randomness would boost chances for women, young researchers, and small laboratories. However, recognized scientists are more skeptical and would—as shown in qualitative interviews (Barlösius and Philipps 2020)—rather implement other measurements in peer review processes, such as block funding, cutting the length of proposals, extending the group of reviewers, and other measures to restrict disadvantages and dysfunctional operations in peer review processes. Hence, there is no clear agreement that random selection procedures will solve all kinds of problems and discrepancies in the scientific field. However, scientists seem to agree on lotteries' 'sanitizing effect' (Stone 2009: 377) if there is the potential for a decision to be made on the basis of bad reasons. This may happen because, for example, all of the good reasons have been exhausted and yet indeterminacy remains (as may be the case when allocative justice is involved). In such a case, a lottery is quite serviceable if there is a real danger of bad reasons creeping in (Stone 2009: 392).

In the context of science and from the viewpoint of the survey participants, one could argue that a lottery is not an alternative to the established selection processes based on merit, which enable reviewers to assess the proposals' qualities. Instead of replacing peer review, random selection should only be an option if non-scientific (bad) reasons are playing a role in the decision-making process. We therefore need a discussion about legitimate (good) and illegitimate (bad) criteria in selection processes for the allocation of funding. Should a decision on funding, for example, only be grounded on the quality of research ideas and their feasibility? Should reviewers exclude in their considerations any other criteria, such as previous contributions, track records, qualifications, and so on? If it is clear what the scientifically acceptable criteria are to finance research, there is a well-defined threshold to be alarmed if inappropriate criteria creep into decision-making processes. It might be used at first to alert reviewers to stick to appropriate criteria. If reviewers continue to violate the defined benchmark, or if disagreements arise and amplify agonistic chance (Roumbanis 2021), a lottery can be applied to make decisive selection apart from any further reasoning. In this regard, random selection will definitely increase the chance of high-risk and unconventional research being financed (Avin 2019; de Peuter and Conix 2021; Gillies 2014; Osterloh and Frey 2019; Roumbanis 2019a). However, there are more and better ways to enhance creativity and innovativeness in science. Block funding, for example, provides stable financial resources as well as thematic and methodological leeway to conduct research beyond proven paths (Heinze et al. 2009; Hollingsworth and Hollingsworth 2011).

This paper comes with some limitations. First, results are based on a sample of scientists who were employed in highly academic contexts in the German federal state of Lower Saxony. All participants were affiliated with universities or extra-university research centers. One can postulate that the views of researchers there, of course, hardly differ from those in other federal states. In this respect, the findings should be generalizable for Germany.[3] However, scientists' perspectives might be different in other countries with greater competition and lower funding rates. Second, the online survey concentrated on PhD holders who affiliated themselves mainly with biology, physics, chemistry, informatics, system and electrical engineering, production engineering, medicine, history, as well as very few with other research fields. This represents a broad spectrum of research fields, but not all. Third, there is a disproportionately larger group of men (73 per cent) than women (27 per cent), which might affect the representativity of the study. At the same time, most survey participants come from fields in life, physical, and engineering sciences with fewer female scientists. Fourth, apart from information about scientists' gender, the survey also collected data on the affiliation of the research institution, academic status, and type of contract. These variables, not examined in this paper, might also affect the views of partaking researchers. Future research should examine in more detail the extent to which different characteristics of scientists can explain variations in their perspectives. Additional research is needed to test findings in other research contexts, as well as to understand the ways scientists approach lottery procedures and other alternatives to institutionalized scientific measures of quality control.

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Notes

1. Software LimeSurvey Version 3.22.27+200720.
2. Total numbers of the Figs 1 and 2 are represented in Appendix B.
3. The Volkswagen Foundation, of course, is situated in Lower Saxony and offers funding schemes only for scientists who work at academic institutes within this federal state. However, locally-based researchers were not privileged in the *Experiment!* funding initiative that employed a lottery.

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Appendix A. Extract from the survey questionnaire

Question 1: Which statements describing the current situation of research funding in Germany do you agree with?
There are too many requests for reviews.
The review process of the DFG meets scientific standards.
For the most part, funding organizations also tolerate non-scientific evaluation criteria.
Competition for third-party funding for research has increased further in recent years.
The selection of reviewers in funding organizations is non-transparent.
The majority of funding organizations stipulates research topics.
With a low funding rate, the allocation of research funds is a matter of mere coincidence.
The majority of funding agencies does not provide constructive feedback after decisions.

Question 2: Looking at the current situation of the use of the peer review process in Germany, how do you rate its functionality?
Peer review processes ensure scientific quality.
The majority of the reviews are written in a perfunctory manner and not very informative.
Applicants are at an advantage if they know the reviewers personally.
Applicants are at an advantage if they have the same research profile as the reviewers.
The majority of the reviewers uses the position for their personal interests.
It is not always possible to justify the ranking of research projects scientifically.
There is a great danger of research ideas being stolen.
The peer review process inhibits the funding of unconventional research.
The majority of reviewers rates research projects with preliminary work higher than those without.
The majority of reviewers is influenced by negative prejudices toward young researchers.
The majority of reviewers is influenced by negative prejudices toward female researchers.
The majority of reviewers is influenced by negative prejudices toward universities of applied sciences.
The majority of reviewers is influenced by negative prejudices toward migrants.

Question 3: What impact would you expect if research funding is allocated randomly? Lottery in research funding…
is fair, as all applicants are treated equally.
reduces the costs and the time required to write the application.
reduces the costs and the time required for the review process.
reduces inequalities through the formation of networks.
prevents the topical controlling of research.
increases the chances of young researchers.
shows no appreciation of scientific achievements.
increases the chances of universities of applied sciences.
reduces the value of third-party funding as a performance indicator.
increases the chances for unconventional ideas without preliminary work.

allows decisions to be made if a ranking cannot be scientifically justified.
prevents the continuity of a line of research.
prevents quality assurance according to scientific standards.
increases the chances for women.
undermines in the long term the notion that science can decide according to purely scientific criteria.
increases the chances of small research groups and research institutions.

Appendix B.

Tables with total values for Figs 1 and 2.

Figure 1. Scientists' views on the current grant distribution in Germany	Agree	Undecided	Disagree	Total
Increased competition for third-party funding	247	10	4	261
DFG operates toward scientific standards	191	36	32	259
Selection of reviewers is non-transparent	179	53	29	261
Too many requests for reviews	170	70	20	260
Funding organization mainly steer research thematically	145	75	40	260
Funding organization mainly provide no feedback	150	60	50	260
Due to low funding rates distribution is random	119	49	91	259
Funding organization mainly tolerate non-scientific criteria	96	78	84	258
Figure 2. Scientists' views on peer review	**Agree**	**Undecided**	**Disagree**	**Total**
Reviewer mainly favor research with preliminary work	252	22	9	283
Peer review ensures scientific quality	243	21	19	283
Applicants benefit if they know the reviewers personally	199	52	32	283
Rankings of proposals are not always scientifically justified	192	42	49	283
Peer review mainly inhibits funding of unconventional research	177	44	62	283
Applicants benefit if they have the same research profile as the reviewers	140	87	56	283
Reviewer mainly disadvantage universities of applied science	81	121	76	278
There is a great danger of research ideas being stolen	85	77	120	283
Reviewer mainly use their position for their own interests	72	64	145	283
Reviewer mainly disadvantage young scientists	63	69	151	283
Mainly sloppy reviews	61	64	158	283
Reviewer mainly disadvantage foreign scientists	29	82	171	282
Reviewer mainly disadvantage female scienstists	20	101	160	281