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Scholten, W.; Franssen, T.P.; Drooge, L. van; Rijcke, S. de; Hessels, L.K.

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Article

Funding for few, anticipation among all: Effects of excellence funding on academic research groups

Wout Scholten[1], Thomas P. Franssen[2], Leonie van Drooge[2], Sarah de Rijcke[2] and Laurens K. Hessels [1,2,*]

[1]Rathenau Institute, Anna van Saksenlaan 51, The Hague 2593 HW, The Netherlands and [2]Centre for Science and Technology Studies (CWTS), Leiden University, PO Box 905 2300, Leiden AX, The Netherlands

*Corresponding author: l.hessels@rathenau.nl

Abstract

In spite of the growing literature about excellence funding in science, we know relatively little about its implications for academic research practices. This article compares organizational and epistemic effects of excellence funding across four disciplinary fields, based on in-depth case studies of four research groups in combination with twelve reference groups. In spite of the highly selective nature of excellence funding, all groups employ dedicated strategies to maximize their chances of acquiring it, which we call strategic anticipation. The groups with ample excellence funding acquire a relatively autonomous position within their organization. While the epistemic characteristics of the four fields shape how excellence funding can be used, we find that in all fields there is an increase in epistemic autonomy. However, in fields with more individual research practices a longer time horizon for grants, beyond the usual 5 years, would fit better with the research process.

Key words: research funding; competition; scientific excellence; research practice; strategic anticipation

1. Introduction

Over the past few decades, many Western governments have introduced specific policies to stimulate what in science policy is nowadays often termed scientific excellence. One popular intervention is to provide highly competitive project funding, allocated based on outstanding 'quality' and 'performance', with little or no explicit consideration of societal relevance or thematic programming, in order to promote groundbreaking research and international competitiveness (Cremonini et al. 2017). We call this type of research funding excellence funding.

The introduction of excellence funding follows upon an increased interest in the concept of excellence in science policy. The term excellence was first used in the 1960s in the USA, referring to the need to overcome 'mediocracy' in science and technology (Flink and Peter 2018). Robert Merton (1973) also contributed to the conceptualization of excellence by claiming that researchers who 'strive for excellence, [also have] the ability to awaken excellence in others', thereby envisaging excellence not as an end in itself for those possessing it, but as something that benefits many because of its mobilizing effects (Flink and Peter 2018). In the 1990s, the concept emerged in the context of European science policies, for instance with EU-funded Networks of Excellence and nationally funded Centres of Excellence (Sørensen et al. 2016). It subsequently became more pervasive by the creation of the European Research Council (ERC), the Research Excellence Framework in the UK, and the introduction of dedicated funding instruments across most OECD countries (OECD 2014).

In the meantime, the notion of excellence has also become contested. According to some pundits, it has no intrinsic meaning in academia and is therefore dependent on who decides on what excellence is (Stilgoe 2014; Nature 2018). It stimulates a form of hypercompetition that can be at odds with norms of good research and actually decreases the quality of research output (Moore et al. 2017). Moreover, there are concerns about the gender effects of excellence policies, including gender biases in evaluating performance and the influence of individual relationships with powerful actors in selecting candidates or proposals (O'Connor et al. 2020).

In the current article, we do not study the notion of excellence as such, instead we focus on the effects of excellence funding. These funding arrangements generate additional capacity for a select number of individuals and research groups at the receiving end and increase the unequal distribution of funding in the science system (Cremonini et al. 2017).

On the system level, excellence funding tends to amplify the Matthew effect (Bol et al. 2018) and leads to stronger concentration of funding. This concentration does not seem to contribute to a better scientific performance in terms of publications numbers or

citations (Aagaard et al. 2020). Earlier research also raises concerns about the epistemic effects of excellence funding arrangements. Excellence funding can create a space for more interdisciplinary collaboration and high-risk research activities (Langfeldt et al. 2015; Hellström et al. 2017), but the competition induced by excellence funding arrangements can also narrow research goals and frameworks of researchers (Whitley et al. 2018) and may even threaten research integrity (Moore et al. 2017).

In spite of the growth of the literature about excellence funding in science, we know relatively little about the implications for academic research practices. In particular, the organizational and epistemic effects deserve further study. A better understanding of these effects can enrich the debate about the effectiveness and undesired side effects of excellence funding. The research question of this article is: How do research groups respond to the introduction and acquisition of excellence funding? We address two sub-questions:

- How do research groups anticipate the competition for excellence funding in terms of organizational and epistemic changes?
- What epistemic effects occur after the acquisition of excellence funding?

We use the credibility cycle as introduced by Latour and Woolgar (1986) as an analytical tool to study the research practices of research groups with and without excellence funding. This enables us to acquire a comprehensive view on their research practices, including both epistemic and organizational aspects. We develop the notion of strategic anticipation to highlight how the introduction of excellence funding arrangements has changed the way in which researchers make sense of their position in the science system.

2. Theoretical framework

2.1 Excellence funding

In this article, we define excellence funding as highly competitive funding arrangements through which funding is allocated primarily based on considerations of scientific performance (often operationalized as numbers of publications and citations), with little direct consideration of societal relevance or thematic programming. The basic principle of this type of funding is to differentiate between a small number of researchers, organizations, or proposals that are considered to be 'excellent' and the rest that is less or not 'excellent'. In many countries, the share of this type of funding in the overall funding composition of university research has increased over the last few decades and has come to replace part of the block funding to universities (OECD 2014; Koier and Scholten 2018). Excellence funding arrangements are grounded in the belief that differentiating resource allocations will produce better performance of the science system. Governments hope that increasing concentration among researchers that perform 'best' will increase effectiveness, decrease low-quality research, and yield more and better outcomes for the entire system, such as breakthrough innovations and the attraction of scientific talent (Cremonini et al. 2017).

An important conceptual distinction is between excellence as a zero-sum game, and excellence as a threshold (Young 2015). Zero-sum excellence can be understood as a relative notion of excellence, used in funding instruments and rankings. Excellence is then the 'best of the best', which means the most highly evaluated, and 'rests on the assumption that excellence is a limited resource that is decided by relative and competitive means' (Young 2015: 8). Threshold excellence rests on the assumption excellence is an unlimited resource and is not relative to the performance of others, but rather a benchmark anyone should live up to.

Excellence funding can be regarded as a new generation of competitive funding. While there has been an ongoing shift from institutional block grant funding to competitive project funding already since the early 1980s, until about 2,000 most competitive funding was still tied to thematic priorities. There have been many studies on competitive project funding, addressing the effects on, for example, research productivity (Jacob and Lefgren 2011; Ayoubi et al. 2019; Aagaard et al. 2020), societal relevance (Hessels et al. 2011), and creativity (Wang et al. 2018). The current article is concerned with funding that is allocated above all on the basis of 'excellence', either in scientific performance or in the potential for scientific performance. Only a limited number of empirical studies have been published on the effects of this specific type of funding so far; the next section will provide a review.

2.2 Literature review

In this section, we briefly review the limited existing literature on the effects of excellence funding on academic research practices. We first discuss system-level effects, then organizational and epistemic effects, respectively.

There have been some studies on the effects of excellence funding on national research systems. Earlier research suggests that excellence policies are more prone to reveal existing but tacit diversity in the system than to generate new relational patterns (Cremonini et al. 2017). In four Nordic countries, the introduction of Centres of Excellence has increased the concentration of resources to a limited number of researchers, although excessive accumulation of resources was avoided (Langfeldt et al. 2015). More general studies on the effects of science funding have also found evidence for a Matthew effect: early funding itself is an asset for acquiring later funding (Bol et al. 2018). It is, however, doubtful whether this concentration will generate the desired increase in scientific performance. A meta-study suggests that concentration of funding does not contribute to higher productivity or citation impact (Aagaard et al. 2020).

With regard to organizational effects, Borlaug and Langfeldt found that Centres of Excellence affect research organization and practices in the humanities. Center of Excellence grants are a specific type of excellence funding aimed at funding groups or consortia of researchers. These centers were found to increase the collaboration between different fields and make disciplinary and organizational boundaries more permeable, but so far they do not substantially alter individual collaboration patterns in the humanities. They further seem to generate more tensions in their adjacent environments compared to Centers of Excellence in other fields (Borlaug and Langfeldt 2020). These effects may differ when excellence funding is oriented at individual researchers.

Gender studies indicate that excellence policies reinforce excellence rhetoric as a 'rationalising myth'. This myth creates particular micro-political practices, including—as mentioned above—(1) a gender bias in evaluating performance, (2) the influence of individual relationships with powerful actors in selection of candidates or proposals, and (3) a focus on 'local fit', essentially stimulating 'inbreeding' (O'Connor et al. 2020). Hellström and colleagues found that Swedish Center of Excellence grants generate organizational capacities, such as recruitment/human capital, data/infrastructure, and various collaborative arrangements (Hellström et al. 2017). Another study of Centers of Excellence in four Nordic countries similarly found these lead to more international recruitment (Langfeldt

et al. 2015). The discourse of excellence also shapes formal and applied selection criteria for early-career researcher positions at the organizational level. A majority of selection committee members consent to university policies and macro-discourses when evaluating early-career researchers, but a smaller group questions and resists these criteria (Herschberg et al. 2018).

So far, there are few publications on the epistemic effects of excellence funding. One study found that the organizational capacities generated by Center of Excellence grants (resource stability) result in epistemic effects such as the extension of research into new problem areas and higher degrees of risk-taking in research (Hellström et al. 2017). An analysis of ERC-grantees found that they could carry out risky and unconventional research, using new methods, developing a new empirical basis, or exploring a new general explanation. This was possible thanks to the time frame, amount of funding, and flexible use of funding provided by the ERC. The interviewees indicated that it would be difficult to fund this type of research from other sources (Nedeva et al. 2012; Laudel and Gläser 2014). Another study also found that Centers of Excellence in Nordic countries facilitate more interdisciplinary collaboration and risk-taking (Langfeldt et al. 2015). Whitley et al. (2018) have found that more competitive funding can narrow the goals and frameworks of researchers. With this type of funding, it is more difficult to challenge mainstream beliefs and assessment criteria. In an earlier article, we have shown that project funding typically generates less epistemic autonomy than prizes (Franssen et al. 2018). Some have argued that the hyper-competition that arises from the performance of 'excellence' lies at the roots of issues in reproducibility, fraud, and homophily, but empirical evidence for this is lacking (Moore et al. 2017).

2.3 Analytical approach

In order to analyze the epistemic and organizational effects of the introduction of excellence funding arrangements on the work of academic research groups, we use the concept of the credibility cycle (Latour and Woolgar 1986). The credibility cycle provides an abstracted representation of the process of knowledge production and shows how research groups accumulate credibility over time in a cyclical process. In this model, the construction of knowledge that comes to count as facts is inherently connected to the accumulation of credibility. Conceived in this way, the research process can be depicted as a repetitive cycle in which conversions take place between money, staff, data, arguments, articles, recognition, and so on (Latour and Woolgar 1986; Hessels et al. 2019).

In this article, the credibility cycle will be used as a heuristic tool to characterize academic research practices. In our analysis we will follow the credibility cycle to describe the research practices of the groups under study, paying attention to both epistemic and organizational aspects.

We expect that the effects of excellence policies will not be uniform across scientific research areas, because of differences in epistemic cultures (Knorr-Cetina 1999), social organization (Whitley 2000), communication cultures (Becher and Trowler 2001), and reward structures (Hessels et al. 2019). For this reason, we will make a comparative analysis of four research groups in different areas.

For this article, we make the conceptual distinction between epistemic and organizational effects of excellence funding arrangements, although we believe epistemic and organizational aspects of research practices are closely connected. By epistemic effects, we mean the aspects of scientific research that concern what knowledge is produced and the way that knowledge is produced. What are the objects and subjects of study? What methodologies are used? What is considered knowledge and how is that communicated with others? The organizational aspects concern the conditions under which knowledge is produced. How is the organization structured, financially and hierarchically? What organizational or national policies do apply to the knowledge production? How is a principal investigator or professor managing her group?

3. Methodology

A qualitative research design is needed to study the responses of research groups to excellence funding arrangements. These responses become evident when studying the research practices of several research groups. A group is the dominant unit in which academic research is organized and carried out. However, what constitutes a group is not unambiguous in every setting, so we have defined it case by case. In some research fields, the main unit of research is relatively small, because of the object of study and how it is studied. In others the main unit is relatively large. How the organization is structured, hierarchically or financially, also determines what constitutes a group.

We have set up a comparative case study design, consisting of in-depth case studies of four groups of researchers that have acquired several excellence grants and prizes—we will refer to these groups as groups with excellence funding—and interviews with group leaders of twelve reference groups at Dutch universities and research institutes. The four in-depth case studies and their respective reference groups stem from four different research domains. The comparison is therefore twofold. First, we compare between groups with and without excellence funding, in order to determine the effects of this type of funding. Second, we compare between the effects of excellence funding in different research domains, in order to account for cultural and epistemic differences, as explained in our analytical approach.

We applied several criteria for our sampling strategy. To select groups in a variety of research cultures that deal with different epistemic objects we followed Whitley's (2000) differentiation of 'the degree of strategic task uncertainty', as a first dimension, and added the level of collaboration that is common and/or necessary as a second dimension (Tsai et al. 2016). Strategic task uncertainty refers to the degree of consensus about the intellectual priorities in a given research area (Whitley 2000). We assume that the degree of task uncertainty influences how researchers compete for available funding. In research fields with higher strategic task uncertainty, this competition will partly be about the choice of the research topic and question. In disciplines with a lower task uncertainty, competition will focus on the chosen approach to address established research questions. Second, we look at the degree of collaboration, because we expect that the way that research groups fund and organize their activities relates a great deal to the scale of collaboration that is common in their discipline.

This resulted in four research fields that fit the various descriptions based on the dimensions:

- Humanities (high strategic task uncertainty and low level of collaboration)
- Social sciences (high strategic task uncertainty and high level of collaboration)
- Laboratory sciences (low strategic task uncertainty and high level of collaboration)

- Theoretical exact sciences (low strategic task uncertainty and low level of collaboration)

From each field/quadrant we selected one group that we studied in depth. These groups are all very successful in acquiring external funding from excellence grant schemes and prizes. In two groups the excellence funding consists of a small number of large grants or prizes. The other two groups have a rather long history of obtaining several large and small excellence grants and prizes. In addition to these groups with ample excellence funding, from each field, we selected three reference groups with no or very few excellence grants and prizes. We studied these reference groups, twelve in total, less comprehensively than the four groups with excellence funding (see Appendix Table A.1 for an overview).

We analyzed the sixteen groups by studying their everyday research practices, operationalized by the credibility cycle (see Section 2.3). Our interviews covered all six steps of the credibility cycle, relating to money, staff, data, arguments, articles, recognition, respectively. Using software for qualitative analysis we coded the interview data to make an inventory of effects of excellence funding across all steps in the credibility cycle. In our results section, we will provide a rich description of the research practices of the four groups with excellence funding, which is structured along this cycle. Shorter descriptions of the other twelve groups, which function as reference groups, are used to show how they contrast with or resemble the groups with excellence funding.

For the four groups with excellence funding, we interviewed between nine and eleven group members of all career levels and in some cases an organizational superior (e.g. a dean or head of department) or an informed outsider (e.g. a department professor or review committee member). For each of the twelve reference groups, we interviewed the group leader. In addition to the interviews, for all sixteen groups, we selected relevant documents (grant proposals, (self-)evaluations, policy documents) and included them in our analysis. In order to protect our respondents, this article will not reveal the particular groups that we have studied. For the same reason, we also conceal the gender of respondents and refer to all of them as female.

4. Results

We structure the results along the four research groups with ample excellence funding in this study. For every group, we discuss the main elements of the credibility cycle and we selectively highlight comparable and contrasting insights from the reference groups. Due to space limitations, we will not explicitly address all six steps of the credibility cycle for each case, but the descriptions all follow the general logic of the cycle from research funding to publications and recognition.

4.1 Humanities

Regarding *money*, all four humanities groups, with and without excellence funding, demonstrate a troubled relationship with excellence funding arrangements, since this type of funding is one of the scarce ways for them to create significant time and space for research, but the competition for funding is very high. Furthermore, they feel this type of funding is not well designed for their research process that usually does not rest on an expensive infrastructure and without the explicit wish to expand a research group to the size of research groups in the laboratory sciences. They prefer grants that have a longer duration. In addition, some argue for smaller grants for humanities research. The group leader of the humanities excellence group was awarded two major prizes in a short period of time. The total prize money (€3.5 million) created the opportunity for the group leader to set up a long-term research program, consisting of three extensive research projects.

The three reference groups are almost completely dependent on external funding to do research, but they did not obtain large grants nor win large prizes. For one of the group leaders, this means doing her research outside office hours, which are spent on education, management, and administration. For the other groups, it means their research funding is a patchwork of smaller grants, coming from several sources. Designing a long-term research line and planning projects far ahead proves difficult.

In terms of *staff and equipment*, the funding is used to pay for a small team of assistants and young researchers, but mostly to provide for the digital infrastructure in which a large network of European researchers can contribute to the work of the professor with *data* and other input. This worked well for this type of research project and shows that humanities research does develop collaborative research practices, drawing on new digital research infrastructures, while remaining committed to single-authored publication practices.

The group leader of the group with excellence funding, does not speak of a group herself, but rather of a hub within a large network. She has no desire to form an elaborate research group in house, with herself as the 'manager' of many group members. Her European network of around 500 researchers provides the professor with many small and some larger contributions to her projects. These contributions consist of descriptions of historical objects, persons, or texts, and more extensive articles on the most important objects/persons/texts.

With regard to *publications*, books, rather than articles, are traditionally important in the humanities, as is also the case for this professor. Because of the long-term research funding, the professor is able to plan a long-term publication strategy. She works on a number of journal articles that will later be transformed into a book. The book ultimately will be her magnum opus, in potential dramatically shifting our thinking on European culture. The professor seldom publishes with co-authors and does not consider publishing a group responsibility or activity. The publication strategy is only moderately focused on the reputation and impact factor of a journal or publisher.

This publication culture and strategy is similar to the three reference humanities groups. However, they experience an increased pressure to publish their results in articles—in particular, academic journals. The pressure originates from departmental demands and in anticipation of selection behavior of research funders. They feel well-cited articles in renowned journals are a necessary condition to compete for funding, which is necessary to find funding for research.

When looking at *recognition*, the prize-winning professor's reputation steadily developed over the course of her career, particularly influenced by her role as editor of an important series of books, and her role as director of an esteemed national humanities institute. She has always been highly visible in her field, nationally and internationally. The two prizes did not add significantly to her reputation. The prizes are seen as a *lifetime achievement* award, therefore rather confirming her reputation than boosting it. The high reputation of the professor enables her to build the large network of experts who contribute (unpaid) to her projects. The prize money

helps to organize international workshops and arrange visits that strengthen the network.

Autonomy is an important issue for the professor. She consequently seeks to strengthen her position vis-a-vis the department by 'rebelling' against the administrative rules. For her research, she is currently primarily accountable to her external funders, and these funding agencies deploy a *laissez-faire* control over the large prizes, because of their nature. These prizes give the winners a great amount of autonomy over the prize money.

Autonomy is an even more important issue for the three reference group leaders, since they more strongly experience interference from their departments with their human resource policy, the necessity for external funding, and the allocation of time for research, education, and administrative tasks. Furthermore, they experience less leeway to oppose departmental interferences. One of the group leaders explains that her department demanded her to apply for a prestigious excellence grant twice, although she did not see the added value of this grant for her work: 'I applied for these grants purely for pragmatic reasons, so [the head of department] would get off my back for a few years, so I could do my own thing. And besides, the research I do and the way I do it is really individual work. For the most part, I would like to do it myself'.

Another group leader describes that she is completely dependent on her department for retaining one of her younger group members. Since the group member did not succeed in obtaining an individual excellence grant, the group leader claims it would be almost impossible to make a solid case for retaining the researcher.

4.2 Social sciences

The large (>€2 million) and prestigious grant that the group leader obtained provides for the main research *money* of this group. It is supplemented by block funding and other smaller research grants. Several Ph.D. students are hired to contribute directly to the grant project. Others were already part of the group and now work partly on the project. Together the group consists of ten to fifteen group members. The grant is guiding the research of the group for the coming years and therefore facilitates a programmatic and relatively long-term research agenda.

The reference groups are more dependent on funding that is focused on the societal relevance of their research. Their external funding exists for instance of a subsidy from a Dutch ministry and funding from the European Framework Programme. In general, since the three groups obtain more small research grants, and external funding with more strings attached than excellence grants (i.e. the calls specify the research subject, collaboration with other partners is required, and agreements are made over specific deliverables), their research agenda is emerging incrementally, depending on what is demanded in these different grants.

In terms of *data*, the research of the group with ample funding is dominated by working on and with large international surveys. These surveys are set up and carried out in extensive international collaborations. For the viability and relevance of the discipline, these large data-sets are of crucial importance. Mostly, the group members do statistical analyses on the data from the surveys that other consortia set up. The large excellence grant provided the opportunity to design and carry out their 'own' survey, among a difficult to reach population. Collecting 'own' data and providing peers with new data from a large survey is one way of gaining recognition in this discipline.

Publishing is strongly structuring the research of the group, within a publication culture that is dominated by writing academic articles for international journals with high-impact factors. Because of the importance of these publications for careers, funding, and recognition, publication strategies are influencing research practices. The research predominantly starts with defining the end product: what journal do we aim for and what will be the composition of the article? Furthermore, project plans are set up on the basis of a number of articles. Even the data analysis is partly dependent on the desire to publish in high-impact journals, since the group members share the idea that publishing in the 'best' journals is only likely when presenting significant results.

The three reference groups apply similar publication strategies, but differ in the degree they struggle with the tension between the dominant publication culture and other aspects of their work, for instance working on the societal impact of their research. They notice a trade-off between the focus on publishing in high-impact journals and the time it takes to contribute to education, administrative tasks, and most notably creating societal impact. A group leader: 'Some postdocs enjoy developing course materials [for secondary schools] and feel that is important to create societal impact. So when they apply for a [excellence] grant they lose out to someone who didn't develop course materials, but instead published articles. Then I think: if I let them work on this [course material], it means they will have a competitive disadvantage when pursuing an academic career, and that is a tough dilemma'.

Although these group leaders do think all tasks are important, they nevertheless might advise their junior group members to focus on academic publishing since that is, in their eyes, the necessary condition within the current system to advance their scientific careers.

Recognition, in the case of the excellence group, comes in many forms, most notably by contributing to large surveys, publishing in high-impact journals, and obtaining large research grants. The group leader explains how the large grant provided her status, predominantly within her own university. She compares the situation with becoming a professor: 'I didn't get any smarter, but everyone suddenly listened to what I had to say.' The university 'uses' her in its external communication (promotion), and her successful grant application serves as a textbook example of how to write a proposal. The recognition of the grant as such leads to more autonomy from university management.

On the contrary, the reference groups experience less autonomy from their respective department or university management. They feel more pressure to prove their reason for existence and they experience less freedom to decide on their human resource management, and financial matters.

Within the group with excellence funding, applying for new funding is seen as a group process and group responsibility, although only individuals can apply for most Dutch and European Union excellence grants. The group leader plays a crucial role in motivating every eligible researcher to apply for funding and in guiding the process of finding the right research question, writing the proposal, and presenting it to the committee. According to the group members she uses her experience with proposal assessment and selection committees to improve their chances.

The three reference groups apply, again, similar strategies for attracting external funding. They also bet on multiple horses and consider grant applications as a group responsibility. As other studies show, grant success is dependent on other factors than merely the quality of the proposal and the quality of the applicant, for instance, prior success (Bol et al. 2018), and random (social) factors (Van

Arensbergen 2014). Next to these factors, we identify the tacit knowledge of how the system works, gained through experience with successful applications and committee work, as an important factor for the acquisition of excellence funding.

4.3 Lab sciences

The lab sciences group with excellence funding is an interdisciplinary group, mostly focused on the field of geosciences, using methods from chemistry. It is formed around two professors, of which one is the group leader. The group is part of a research institute and therefore most group members do not have educational responsibilities. The two professors are also appointed by a university and are therefore entitled to supervise Ph.D. students. The group consists, besides the professors, of three tenured researchers, ten to twenty postdocs and Ph.D. students, and a few analysts who are also permanent staff.

The group has a long history of successfully obtaining external research *money*. For decades, they have been dependent on external funding for their research projects. Without external funding, they would have no early career researchers who do most of the research work. Group members have acquired several large individual excellence grants and prizes as well as large excellence grants meant for consortia. The group even decided to temporarily stop applying for funding, because the workload would get too high if they were to start new research projects.

The research of the three reference groups is much less funded by excellence funding. The reference groups do submit proposals for excellence grants, but generally they are less focused on this type of funding. They are evenly dependent on external funding and receive funding from industry as well as from thematic grant schemes. These projects are often short term. The research evaluation report of one of the reference groups described their research agenda as 'opportunistic rather than strategic'. The group leader: 'I normally work opportunity driven, that is why we lack a strong focus. Six years ago it took no great effort to attract money from the ongoing collaboration with [large companies]. But now that is increasingly difficult. To maintain the group size and stature I need to compete for large [excellence] grants, and that is why it is very important for me to better position, focus, and brand my research.' The group leader is now working on an application for an ERC Advanced Grant.

In terms of *equipment*, the group with excellence funding possesses its own advanced laboratory. Some of the devices are funded by grants; others are acquired with basic funding. The laboratory is one of the most important assets of the group. The facilities attract research partners to visit or collaborate with the group because the facilities are high level and scarcely available. Most (70 per cent) of their articles are written in collaboration with researchers abroad.

The reference groups have different ties with the laboratories they use. In one case the group was newly formed, and the group leader was permitted to set up a new laboratory space when she was appointed. Another reference group shares most of its facilities with a number of other research groups. The third reference group took responsibility for a part of its laboratory when it became apparent that it could not financially sustain itself. External funding is now not only needed to appoint Ph.D. students and postdocs, but also to finance the laboratory and the permanent analysts.

Regarding *staff*, research in the group with excellence funding is a team effort, with a specific division of work. Analysts manage the laboratory, support the ongoing tests and experiments, and teach new researchers how to use the devices. The tenured researchers supervise the postdocs and Ph.D. students on a day-to-day basis and are the key figures for communication between the professors and the rest of the team. The two professors also spend a considerable amount of time on supervision. They further deal with strategic decisions, such as applying for funding, their research agenda, and positioning articles for publication.

The group is highly productive in *publishing* articles. Writing articles is a collaborative process, with most researchers involved. The professors set the quality standard. They guide the younger researchers in the writing process and contribute themselves in the final phase. The group decides upon their publication strategy—who writes what for what journal—pragmatically and collaboratively, but the group leader has the final say.

The reference groups have similar publication strategies; however, they pursue impact in a more diversified way than primarily through publications in top-tier academic journals. One of the reference group leaders appointed one associate professor who is solely focused on societal impact and collaboration with industry. Another group leader considers her administrative role as vice-dean of the department and her education responsibilities evenly important as her research.

The excellence group's *recognition* consists of several elements. First, the work of the two professors is well-known among colleagues; they belong to the most cited authors in the world. Second, their advanced facilities attract many external researchers who want to work with the group. Third, the group is internationally highly visible. They often work together with international colleagues and are active on conferences and in editorial boards. They select their collaborating partners based on the partner's reputation and added value to the research projects (in terms of data, knowledge, or instrumentation).

The recognition for the reference groups is, similar to their funding sources and impact, not so much dependent on their research achievements as such as it is on their work with industry and application of their research. For instance, one of the reference group leaders made an important contribution to the research that led to a large 'blue energy' project (where fresh river water joins salt sea water, also called osmotic power). Furthermore, she appeared on a famous national television show. Another reference group leader states she is most proud of the five commercial spin-offs that originated from the research group in the last 15 years.

In general terms, the reference groups find their pursuit for diversified impact, funding, and recognition problematic, because the absence of excellence funding as 'proof' of their research quality is not easily compensated by their achievements in terms of education or societal engagement. They experience a continuous pressure, to a lesser extent by their peers, and above all by their organizational superiors to compete for excellence funding.

Different grants and prizes serve different purposes in the group with excellence funding. New avenues for research often start with an unforeseen 'discovery' from another (externally funded) research project. When the idea is further developed, for instance in a published article, the group professors use the idea to apply for additional funding. One of the professors explains she normally seeks the perfect middle ground for her excellence grant applications between the most innovative ideas and ideas with a high certainty of success. Truly innovative research ideas are made possible with prize money and the large excellence grant for consortia, because these subsidies are less bound by an already established and approved project plan. The prize money also serves as a flexible reserve to be used as a

'lubricant' in the research process and to quickly react to new developments (Franssen et al. 2018).

4.4 Theoretical, exact sciences

The exact sciences group with excellent funding works in mathematics. This group is characterized by a highly individual research process, but also by a high level of group identity, behavior, and strategy. It is part of an explicit policy to leave as much as possible research-oriented autonomy and responsibility at the individual level. Other organizational matters, such as participation in larger networks, financial issues, and human resource management are carried out at the group level. This policy and the nature of mathematical research—being mostly theoretic and with minimal use of expensive facilities—establish a deliberate ad hoc and emergent research line. The group consists of about fifty researchers, which form one-half of a mathematical institute at a comprehensive research university.

In terms of *money*, the group has witnessed a steady increase in their budget and therefore group size over the last 5 years, mostly coming from external project funding. To be more precise, several senior researchers have obtained excellence grants and prizes ranging from €1.5 to €2 million over the last 20 years. Younger group members have won multiple smaller excellence grants (0.2 to €0.8 million).

The group with excellence funding is very conscious about their funding opportunities. Since they are doing mostly basic research, they prefer excellence funding over thematic grants and working with industry. The group management stimulates every researcher to apply for excellence funding. Senior professors and other colleagues help researchers to write good proposals. When a new grant is awarded, all the colleagues gather and celebrate with cake.

Group members normally do not write proposals that deviate much from their built-up expertise. And they do not propose their most innovative ideas. Their proposal usually consists of some elements that are rather straightforward and 'safe', and some elements that are more ambitious and 'risky'. The same holds for the reference groups.

The money from excellence funding arrangements the group members have acquired does not have a great impact on the research that is carried out. Group members explain that excellence grants at best accelerate their research, because it gives them the opportunity to slightly alter their time division between research and education or administration. Without excellence grants, they will carry out their plans nonetheless.

Indeed, the reference groups are not carrying out research that is significantly different than research in the excellence group. One of the reference group leaders explains that she has a special focus on the application of her work in health research. It is important for her group to keep this focus, so she can compete for funding in this domain, where there are more funding opportunities.

The prizes fulfill a different purpose in the excellence group. One of the prize winners explains she used most of her prize money to hire another professor that was skilled to manage and further professionalize the group and to create a vibrant academic culture, inspired by a prestigious university abroad where they both worked.

External funding is reallocated internally, so the subparts of the group (and institute) where funding is abundant, partly fund the subparts where funding is scarce. According to the group management, this prevents disproportional growth of some parts of the institute and therefore keeps relations healthy. In some cases, their independent financial and human resource policy conflicts with their faculty management, but there are no consequences for the group. As a group professor says: 'Most policy makers don't like it when we say: "we don't need your policy". But when things work out well, it is hard for them to say we didn't do well strategically.'

In theoretical, exact sciences, since large facilities are absent, the most important decisions concern the selection of *staff*. This group has a past of attracting renowned professors, partly based on their potential to attract excellence funding in the near future. Since the group is well-funded, the group can deploy a flexible human resource policy. They often wait for the right candidate when a position opens up. In other cases, they take the risk of hiring a new professor without having a vacancy. In this way, the group is known as proficient in attracting outstanding senior researchers. Furthermore, the group created their own tenure track, distinct from the faculty-wide used tenure track.

There is no explicit *publication* strategy. In the field of mathematics, publishing articles or books is important, but there is less need for peer review or publication in renowned journals to label work as excellent. The proof as such is what is valued and can very well be presented at conferences or in articles that are not (yet) peer reviewed, as is the case with many articles on the open online article database *arXiv*. The group resists the general incentive by their department to publish often and in journals with high journal impact factors, as is a more common strategy in the other department's disciplines like biology or chemistry.

Concerning *recognition*, the group's reputation is mostly dependent on the individual reputations of a number of internationally renowned professors. Furthermore, the group works on a select number of subdisciplines within basic mathematics, which allows them to excel by building capacity on these topics. The group is also internationally visible by taking part in and initiating international partnerships and networks. International visibility in networks and through the acceptance of articles at international conferences is important to build a good reputation.

The reputation of all four exact sciences groups is also dependent on the history of the group or department. It is built on the work of former renowned colleagues that can still be highly relevant and acclaimed.

The comparison with the three reference groups confirms how independent and autonomous the excellence group can operate. The reference group leaders experience that their degree of autonomy is strongly dependent on the goodwill of their superiors towards the groups' financial and human resource plans. In some cases, management is unfavorable and direct funding is decreased for the groups. One of the group leaders: 'In the end the faculty management decides on who to hire. And the faculty management imposes the tenure track conditions. It has to be an all-rounder, but acquiring research funding is certainly the most important. And that is very difficult for us.' Or they find themselves competing for direct funding and internal recognition with other groups in their faculty like physics or chemistry, which is often difficult because of their distinctive research and publication culture. A group leader: 'The direct funding we received through our department gradually decreased. We can keep explaining that our field is different from chemistry and physics [the other fields in the department], but they do not respond. This will always be a struggle.'

Theoretical, exact sciences have a difficult relationship with excellence funding. They experience a hard (and sometimes uneven) competition with other disciplines such as physics, chemistry, biology, and astronomy. Furthermore, interviewees from groups with

and without excellence funding claim that their work is not quite suitable for direct societal relevance and planning research projects, because of the unpredictable research process.

5. Comparative analysis

This section presents a comparison of the findings across the four fields in our study.

5.1 Organizational effects

The organizational effects we observe in the sixteen research groups revolve around organizational autonomy and strategic anticipation. The four groups with excellence funding develop differently than the reference groups in terms of autonomy. Their strategic anticipation, however, is quite comparable.

In all four quadrants, we find the group that acquires ample excellence funding also acquires a relatively autonomous position within their department and/or university, comparable to what Gläser et al. (2014) have named 'protected space'. This autonomy comes in different forms. The humanities group leader is one of the most acclaimed professors at her university by winning two main prizes for her work. This gives her a strong position to 'rebel' against administrative rules and regulations. Moreover, she is only accountable toward her funders for how to spend her prize money, not to the university. The social sciences group serves as a textbook example of 'excellence' within her university. The lab sciences group is autonomous by virtue of their 'own' facilities, partly funded by external funding. Furthermore, the group leader has full control over the prize money that she can use for multiple purposes and therefore serves as 'lubricant' in their research. The mathematics group is highly organized, and their institute is so successful the department or university is very reluctant to get in their way. This results in a deviating human resource policy, and limited adjustment of their research agenda to departmental focal points.

Two main elements of their autonomous position are (1) the internal recognition that comes with winning large prizes and excellence grants, and (2) the funding itself, enabling the groups to act autonomously within their organization and limiting the organizational control over the groups. Because of the developed autonomy, the four groups experience an improved flexibility to make decisions that suit their further development, without much limitations coming from their department or university management. This flexibility mostly concerns human resource and financial decisions.

In all sixteen groups, we find behavior that we label as strategic anticipation (drawing on Müller 2014, see also Franssen and De Rijcke 2019). Müller quotes Adams et al. (2009) to describe anticipation as a state in which '[t]he present is governed, at almost every scale, as if the future is what matters most. ... As an affective state, anticipation is not just a reaction, but a way of actively orienting oneself temporally' (Müller 2014: 4). This concept reflects behavior we have observed, indicating that researchers are continuously aware of future grant opportunities. They are considering how their current choices might increase or decrease their future chances of grant success. This might be partially due to the temporal limitations in most excellence funding arrangements where one has to have a curriculum vitae that shows one is suitable for a particular role (starting a research group, extending one, etc.) by a specific number of years after Ph.D. Remarkably, the behavior is rather similar in all sixteen groups.

Publication strategies are at the core of this anticipation, especially in the non-successful groups. Group leaders and group members alike, think publication strategies (where, when, what, and with whom?) are critical for the viability of the group and for a future career in academia. This includes the perceived importance of article publications in renowned journals for future success in excellence funding schemes, since in their view selection committees primarily focus on the number of articles and the journals they were published in as signs of an 'excellent' curriculum vitae. Even within the humanities and the theoretical exact sciences groups, where publication traditions are less aimed at article publications in high-impact journals to receive recognition from the peer community, article publishing is deemed important to compete for excellence funding and to advance one's career. For the reference groups, this is even more the case, since there is pressure to do better in the competition for project funding.

Managing younger researchers emerges as one of the struggles for most group leaders. On the one hand, they wish to support their younger group members to make independent decisions on their future careers as academics, maybe focusing on education, outreach activities, or less high-impact forms and fields of research. On the other hand, the group leaders feel obliged to stress that the younger researchers have more chances to continue their academic career by aiming on high-impact research output and successfully acquiring excellence grants and thus focus on developing a curriculum vitae that fits with the particular criteria by which one is assessed in such funding arrangements.

Most research groups carefully plan grant applications. We find that applying for excellence funding is considered a group responsibility and group activity, even though most of these are personal grants. In some groups management and senior researchers 'manage' the applications for certain grant schemes. In most cases, every researcher is encouraged to apply for excellence grants. In a single case, it is decided who can and who cannot apply, to maximize the chances. Working on the topic of the proposal, positioning the proposal in academic debates, and writing the proposal is a group process where the professor or group leader often guides early career researchers and adjusts their approach where needed. In this process, the interests of the group coincide with the interests of the individual researchers; both try to maximize the chances of success.

Researchers attempt to write proposals that are not (only) the best proposals from their point of view, but also are adjusted to what they think (or know) selection committees appreciate. Two strategies emerge from our study. The first is to only apply with a proposal that is in line with one's curriculum vitae, so the committee sees a match between the curriculum vitae and proposal. Radically changing a research focus will diminish the chances of success, is the general assumption. The second is that the proposal should keep the middle ground between high risk and run of the mill. Although most excellence funding arrangements theoretically focus on innovative research, researchers feel the most innovative research proposals are not likely to be awarded. These organizational strategies also have epistemic consequences.

From outside the groups, there is pressure from the department or university management to apply for excellence funding. From the perspective of university management it is important for their organization to acquire external funding because it allows them to grow, attract staff and students, and, overall, raise the reputation of the university or institute.

In this regard, we do find some differences between the four groups with excellence funding and the twelve reference groups. The

former seem to experience somewhat less organizational pressure to acquire new research funding, because they do not need to 'prove' their excellence anymore. Moreover, these groups feel a weaker need for anticipation, because there is ample funding for the coming period, and/or because their experience with funding applications will make future funding acquisition easier (Bol et al. 2018).

5.2 Epistemic effects

We find that the four groups with ample excellence funding are able to do more research and can fund specific additional research activities. The social sciences group, for instance, could carry out a large survey while before they worked with existing datasets. The humanities group could set up a large network of contributors to a digital database, while before mostly working individually and occupied with education. The lab group could obtain advanced facilities and hire a new tenured researcher to explore new interdisciplinary avenues, impossible without excellence funding.

We described how the four groups with excellence funding benefit from an autonomous position within their organization. We observe a similar dynamic concerning epistemic autonomy. In other words, the four groups with ample excellence funding can, more easily, decide autonomously on their research topic, research strategy, and methods, and the circumstances under which they do their research. We see two main mechanisms that cause this. First, the four groups are in control of their research agenda. They experience fewer external factors (e.g. funding program demands, organizational/management demands) influencing their research agenda than the reference groups. Second, the four groups with excellence funding are more flexible in deviating from their established research agenda, when the circumstances give them reasons to do so. In comparison to other kinds of external funding (from thematic programs and funding from industry), excellence funding only has few strict obligations. Even when carrying out a research proposal, researchers are relatively free to change their plans along the way. Especially research funding from prizes can function to adapt to emerging circumstances, for instance, to seize opportunities following serendipitous events, or to cope with unforeseen difficulties or misfortune (Franssen et al. 2018).

Furthermore, in Section 4 we describe how the four groups are better able to establish a long-term research agenda, while the reference groups are mostly working with short-term grants, with more limiting conditions. They, therefore, find it hard to establish a long-term research agenda. The four groups with excellence funding find it easier to profile themselves by working on similar and long-term research projects.

6. Concluding discussion

Across many science systems, we witness the rise of excellence funding, allocated primarily based on considerations of scientific performance (often operationalized as numbers of publications and citations), with little direct consideration of societal relevance or thematic programming (Cremonini et al. 2017). There is a large literature on the effects of competitive funding on academic research practices (see Aagaard et al. 2020 for a review), but empirical studies dealing in particular with excellence funding are scant. The research question of this article is: How do research groups respond to the introduction and acquisition of excellence funding?

We expected the influence of excellence funding arrangements to differ according to the two dimensions through which the cases were selected: the level of strategic task uncertainty and the degree of collaboration. We assumed the theoretical, exact sciences groups, and lab sciences groups to have a lower level of strategic task uncertainty—there is more or less consensus on the intellectual priorities in the research fields in which they operate. In (quantitative) social sciences and lab sciences, there is typically more collaboration. Research in theoretical, exact sciences, and the humanities are less decomposable and therefore publications are more often written by a single author.

In contrast to our expectations, however, it appears that the two dimensions do not substantially influence the organizational responses of the groups to the increasing importance of excellence funding arrangements. In fact, the organizational responses are surprisingly uniform. Building on Müller (2014), we characterize these as 'strategic anticipation'. The way in which the groups anticipate the competition for excellence funding is not only similar between groups with and without ample excellence funding, but also across both dimensions of our case selection framework. Likewise, the dynamics concerning organizational autonomy is similar over the two dimensions. We observe an increase in autonomy thanks to the acquired excellence funding in the humanities, social sciences, lab sciences, and theoretical, exact sciences groups alike.

The similarity in response is likely due to the overall shift in the available funding in the Dutch science system from unconditional block-grant funding to competitive project funding. Academic research groups increasingly experience a scarcity in, and therefore competition for, research funding. In this situation, the acquisition of excellence funding, with little strings attached, is highly attractive because it leads to greater autonomy, or protected space (Gläser et al. 2014), across all domains. Furthermore, as we find in our study, the relationship between the research group and its organizational superior is of substantial importance. The superior can incentivize groups to compete for excellence funding and facilitate their autonomy.

Regarding the epistemic effects on research, we find differences between the more individual versus more collaborative, coordinated research fields. In the more individual fields, some scholars report a difficulty to adjust their research practices to the duration and size of grants. Both the humanities and theoretical, exact sciences groups state they prefer longer grant durations over the current maximum duration of 5 years. In both cases, we find that large prizes, that is, funding with very few constraints and commitments, play an important role in the development of the research groups. For the social sciences and lab sciences groups, which work and publish in a more coordinated way, the numerous and large excellence grants and prizes positively influence the scale of their research, which translates into advanced possibilities for data collection and analysis (large-scale surveys and state-of-the art lab facilities). In other words, these groups gain the possibility to substantially alter their research practices through these funding arrangements.

With regard to epistemic autonomy, we find that excellence funding increases control of the research agenda, enables establishing a long-term research agenda, and increases the flexibility to deviate from the research agenda. As such, excellence funding can help research groups to act as front-runners in their field by influencing the research agenda in their research area.

We will close our article with a reflection on the desired and undesired effects of excellence funding. Excellence policies aim at a selective group of extraordinary researchers, but affect a broad range of researchers. Following the policies' logic, the benefits for the selective group of researchers would trickle down and produce better

performance of the science system as a whole. Our study shows excellence policies indeed have a broader effect on the science system than only for these extraordinary researchers, but not in terms of a better performance. That is, a broad range of researchers are anticipating this kind of funding in the organization of their work and feel the pressure to compete, but only a small number of researchers benefit epistemically and gain more recognition and autonomy.

Some groups profit from these specific funding arrangements and can do significantly more or different research. Therefore, to cease excellence funding altogether does not seem desirable. Nevertheless, adjusting these programs or the responses to the programs seems necessary to limit the formative (side-)effects of these funding arrangements on the research practices of many research groups in multiple research areas who anticipate the inevitable competition for excellence funding.

Our first suggestion is to make sure excellence funding arrangements are not considered a general standard all researchers should compete for (Scholten et al. 2018). One way to stimulate this change is for funding agencies to decrease the budget for excellence funding arrangements, allocating the rest of the budget to other funding programs or as block funding.

Second, based on this study we would encourage universities and research institutes to facilitate a differentiated approach to rewarding and recognizing research performance, opening up to different notions of quality and/or performance that are not connected to excellence funding arrangements and quantitative measures of research quality. This suggestion is in line with a recent position paper of the Association of Universities in the Netherlands 'towards a new balance in the recognition and rewards of academics' (2019). Furthermore, initiatives for responsible use of metrics for research assessment (San Francisco Declaration on Research Assessment; Leiden Manifesto for Research Metrics; Hicks et al. 2015) have gained momentum. Funding agencies would not only have to adjust instructions for selection committees to responsibly use research metrics, but also adjust funding arrangements to fit different research areas, for instance by changing the size or time duration of grants to fit discipline-specific needs.

Both suggestions require research managers, funders, policymakers, and other stakeholders to reconsider the concept of excellence (see also Nature 2018). First, stakeholders should realize that they themselves have constructed the meaning of excellence, performance indicators, and research policies (Ferretti et al. 2018). Consequently, these stakeholders together can construct alternative notions of excellence by changing policies, funding arrangements, metrics, and indicators. Second, a (relative) 'zero-sum' notion of excellence should not be confused with an (absolute) threshold notion of excellence (Young 2015). Therefore, relative notions of excellence, for instance, in rankings or funding allocation, should only play a marginal role when assessment is not a zero-sum game, such as in annual appraisal interviews and research group evaluations.

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Appendix

Table A.1. Overview of research groups studied.

Research domain	(Sub)discipline	Size and composition	Excellence funding (in €)
Humanities			
	Culture	One full professor ±5 FTEs (including six student-assistants)	Large prize (>2 million) Medium prize (0.8–1.5 million)
	Language & History	One full professor ±3 FTEs	
	Area studies	One full professors ±5 FTEs	
	Culture & History	One full professor Two endowed professors ±10 FTEs	
Social sciences			
	Demography & Sociology	One full professor ±10 FTEs	Large grant (>2 million) Several smaller grants (<0.8 million)
	Sociology	Three full professor ±20 FTEs	
	Sociology & Health policy	One full professor ±10 FTEs	
	Demography & Sociology	One full professor/senior researcher ±10 FTEs	
Lab sciences			
	Chemistry & Geosciences	Two professors/senior researchers ±20 FTEs	Large prize (>2 million) Two large grants (>2 million) Five smaller grants (<0.8 million) Two large consortia grants (size unknown)
	Chemical Technology	One full professor ±10 FTEs (setting up new group)	
	Chemistry	One full professor ±50 FTEs	
	Chemistry	One full professor ±20 FTEs	
Theoretical, exact sciences			
	Mathematics	Four full professor Two endowed professors ±50 FTEs	Large prize (>2 million) Medium prize (0.8–1.5 million) Five smaller grants (<0.8 million)
	Mathematics	One full professor ±5 FTEs	
	Computer science & Mathematics	One full professor ±10 FTEs	
	Mathematics & Physics	One full professor ±10 FTEs	