January 2017

Interim Evaluation of Horizon 2020

IMPROVING FUNDING FOR INNOVATION: AN EARLY-CAREER PERSPECTIVE ON EUROPEAN SCIENCE FUNDING

FENS KAVLI
NETWORK OF EXCELLENCE

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Summary of Recommendations

The current state of European funding for early- and mid-career independent scientists is more challenging than ever before. Despite their pivotal role as innovation drivers, emerging group leaders find it often difficult to compete with established senior scientists who routinely attract the lion's share of the funding. To provide well-founded recommendations on how to improve funding for the emerging generation of European innovators, the FENS Kavli Network for Excellence (FKNE[1]) in neuroscience conducted a Europe-wide survey for early- and mid-career independent researchers to better understand their needs and wishes. In the following pages we put forward four key recommendations that emerge from the answers of over 300 respondents. Specifically, we recommend to:

1. Take every action possible to guarantee gender equality in science. In our survey we found substantial gender differences in success rates, pay, lab size, anxiety about career prospects and other markers of academic success. It is of utmost importance that Horizon 2020 funding schemes continue to countersteer against these lingering effects of gender discrimination in academia. Self-regulating a balanced distribution of awarded grants that takes into account the number of submissions will be a step in the right direction.

2. Create more specifically tailored funding instruments for early-career-PI opportunities. In many EU member states, European Research Council (ERC) grants are a prominent (and sometimes sole) mechanism for starting/consolidating a lab, but success rates are very low. Most other Horizon 2020 (H2020) funding instruments cannot provide adequate opportunities for supporting emerging European scientific leaders. More specifically, collaborative, and network grant schemes often come with high administrative burden, generally low acceptance rates, and the added difficulty of finding consortium partners at an early career stage. We therefore recommend an increase in the available funding tools specifically tailored to early-/mid-career scientists and a special attention to promoting the participation of emerging European science leaders in all H2020 funding schemes. This can take the shape of increasing the number of available single PI-driven grants, but also by creating dedicated "young networks" grants, specifically for early career scientists with their traditionally smaller networks, or by requiring the participation of a minimum number of young PIs in H2020 projects.

3. Streamline the current ERC grant application system into a true 2-stage application system. All current ERC applications require the submission of a research proposal in two parts, part B1 & part B2. The latter is used only to assess applicants who successfully pass the first stage of the application process. Taking into account the self-reported work hours for Part B2 and the total number of rejected applications in stage one, we can calculate the total researcher time wasted on a one-step ERC application process. This amounts to a staggering 13,000 researcher hours (60 researcher years) per call, time that would be better spent on scientific discovery. We think the current process can be streamlined, with huge benefits for the entire European research community, by truly separating the application

into a two-step process. Only candidates who emerge short-listed according to a (short) part B1 should be invited to submit a long and significantly more work-intensive part B2.

4. Streamline the reviewer system to match project and reviewer expertise and allow feedback. Among scientists, ERC grants are currently recognised as the best funding instrument within H2020, independent of application success or failure. However, the level of satisfaction with the review process of ERC grants in our survey was 50%. This is due to several factors, but two reasons stood out: A) The perceived low amount of time reviewers spent on individual grants, and B) a lack of expertise in the field of the application (as reflected in the quality of the review). This is especially frustrating, given that the amount of time spent on an individual application can be several hundred hours. We recommend 3 simple steps to alleviate these problems: 1) Create larger panels of experts within each field, based on recommendations from ERC grantees and panel members, who will nominate reviewers for each application; 2) use nominated reviewers for stages 1 and 2 and pay them for their work and 3) systematically use applicants' feedback on the reviews to ensure a consistently high quality of reviewers.

We believe that these improvements to the current Horizon 2020 Framework programme should be relatively easy to implement. Importantly, they would significantly improve the funding process through H2020 and bring overdue relief to European early- and mid-career PIs to support this important pillar of European science and innovation.

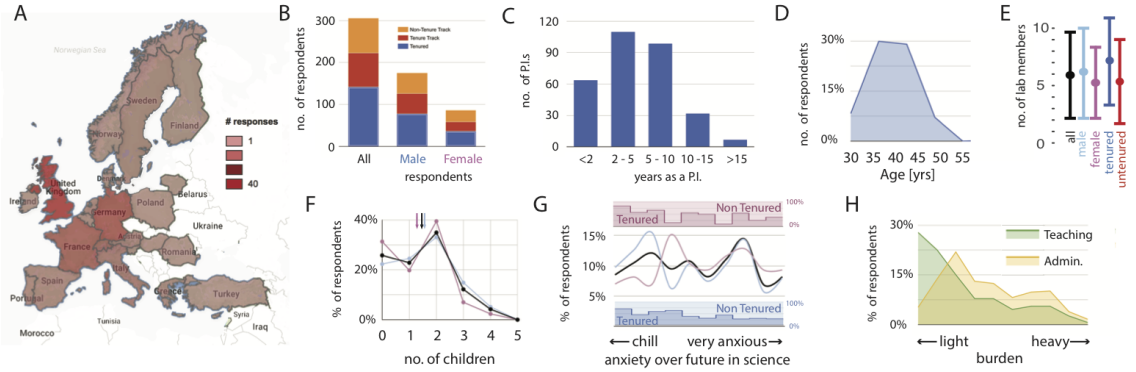

Figure 1: General demographics of survey respondents. Number of responses by: A) country, B) tenure status and gender, C) years of experience as a PI, D) age, E) lab size, F) number of children, G) anxiety over job security (all responses in black, male in blue, and female in red. Each data point is also separated in tenured and nontenured in the histograms above and below), and H) burden of teaching (green) and administrative workload (yellow).

Introduction: The FKNE survey

With €77 billion of funding currently available, Horizon 2020 is the biggest multinational research program in the world. It is widely popular and one of the biggest success stories of the European Union. As such it plays a pivotal role in promoting scientific excellence and innovation in Europe. Given the available funds, H2020 is a key asset for the ability of Europe to tackle societal challenges as well as developing and maintaining a leading role as a knowledge economy. It is therefore paramount that the structure of H2020 is optimized for promoting the best possible science.

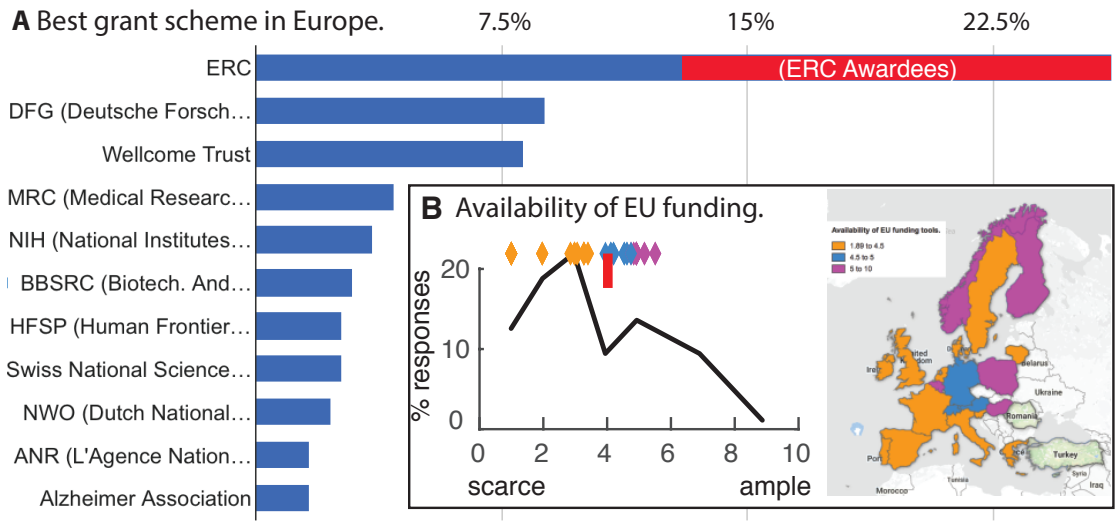

Figure 2: A) Respondents were asked to name their favourite grant scheme. Even when discarding successful ERC awardees from the result (red bar) the ERC was still the most popular funding scheme. B) Respondents were asked to rate the availability of EU funding. Results were plotted as a histogram (left), and sorted by country (right). Orange filled countries scored availability as below average (red line on the histogram), blue and purple nations scored availability as above average. Diamond shapes (left) show national averages.

Early and mid career independent researchers form a vital pillar of the European research ecosystem. Their pivotal role is explicitly recognised by the creation of the starting and consolidator grants offered by the European Research Council. Despite this effort the general trend within Europe is for funding to be allocated preferentially to more senior scientists[3].

The FENS Kavli Network of Excellence (FKNE[1]), is a group of competitively selected early- and mid-career principal investigators (PIs) in neuroscience. It was founded in 2014 with the goal of fostering exchange - at the scientific and science policy level - between

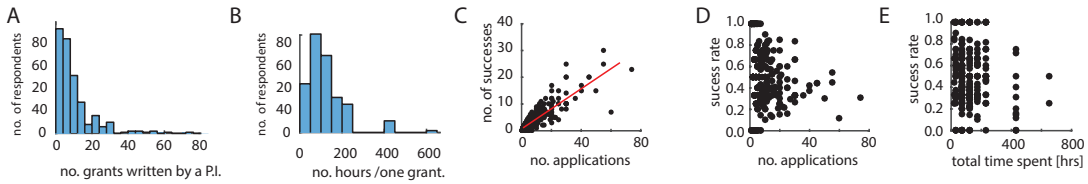

Figure 3: Self-reported submission and success rates: Distribution of: A) number of grants written in the life time as a PI, B) average number of work hours spent of a single grant. C) Number of submitted grants vs. number of successful grants (red line is best linear fit). D) Number of submitted grant applications plotted against (self-reported) success rate). E) Total number of hours spent on grants as a PI plotted against success rate.

emerging neuroscience leaders in Europe. In 2016 the FKNE decided to perform a survey aimed at European early-/mid-career PIs to be able to identify success stories as well as bottlenecks in current European funding schemes. This has allowed us to substantiate a set of recommendations for revising Horizon 2020 and future Framework programmes.

Questions ranged from personal grant writing experience, success rates, level of satisfaction with current funding schemes, time investment, and various types of encountered bottlenecks in the application process. Responses were personally solicited by all members of the FKNE between April 15th and June 15th, 2016.

Results

We received responses from 312 early- and mid- career scientists (175 male / 86 female / 51 undeclared) from 24 European countries (Fig. 1A,B), mainly under the age of 45 years with less than 10 years of experience as a PI (Fig. 1C, D). Lab sizes varied, and differed substantially between male and female respondents. More than 30% of respondents considered themselves very anxious about the future. Here, too, gender differences could be observed in that the non-anxious males (with scores in the lowest quadrant, Fig. 1G) were on average less anxious than their female colleagues. Administrative workload was

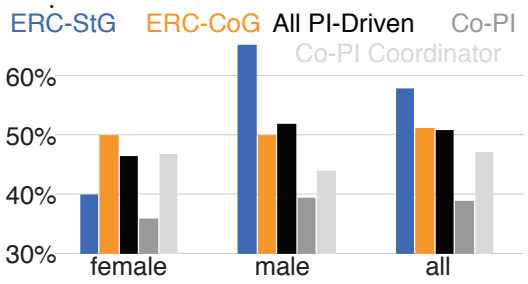

Figure 4: Participants' success rates for PI vs. collaborative grants. Young PIs have much higher success rates in obtaining PI-driven rather than collaborative (Co-PI) driven grants, even if the former are very competitive like ERC grants. Men generally outperform women.

judged to have a major negative impact on the scientific productivity of the participants. The teaching burden on the other hand was generally not considered as big an obstacle to scientific success. Most participants had extensive experience in applying for funding with the number of submitted grants generally varying between 5 and 40 (Fig. 3A), with an average of 122 hours (∼2 weeks) of preparatory work per grant (Fig. 3B). Success rate averaged 51% (although highly variable), and did not correlate with the number of submitted applications (Fig. 3D), nor with the total number of hours spent on grant writing (Fig. 3E).

Recommendation 1: Ensure gender equality in awarding grants

There were substantial gender differences in the success rates of female and male (Fig. 4) applicants for almost all solicited grant categories, with the notable exception of ERC Consolidator grants (Fig. 4A,B, orange bars). To the contrary, ERC Starting Grants were most unevenly distributed between genders (Fig. 4A,B, blue bars). Systemic gender inequality can be observed throughout the survey, e.g. also in lab size, level of anxiety about their career (Fig. 1), but also in lower income, higher number of childless PIs, or higher proportion of child-raising commitments within partnerships, etc. (not shown). We are already aware of certain actions on the side of the ERC to minimise gender differences, but it is worth repeating that all efforts must be made to eliminate gender as well as any other kind of discrimination in the search for academic excellence. We recommend that in all H2020 funding schemes, explicit measures are taken to minimise gender inequality, such as for example prioritising proposals receiving the same grade, according to the percentage of female PI participation. The career stage of applicants should be explicitly taken into account for ranking proposals within any scheme, and should factor in documented career breaks, for example as done for ERC Starting Grants (StG) and Consolidator Grants (CoG).

Bottlenecks for scientific success

The main bottleneck in the current funding situation for early-/mid- career PIs in Europe is the low success rate of existing funding schemes (Fig. 5). The underlying reasons are manifold and include general research budget cuts as well as the diversion of a large portion of the EC budget to support risky research[2,3,4]. Respondents of our survey identified the lack of PI-driven grants, which are currently limited to the ERC, as additional major obstacle to European funding (Fig. 5). The relative dearth of PI-driven funding in favour of network-driven grants is particularly difficult even for scientifically excellent early-career PIs. The short track records, limited coordinating experience and generally small(er) networks of collaborators in early career steps shift the odds towards senior, well-connected PIs in funding competitions. In fact, 92% of our respondents agree with the statement

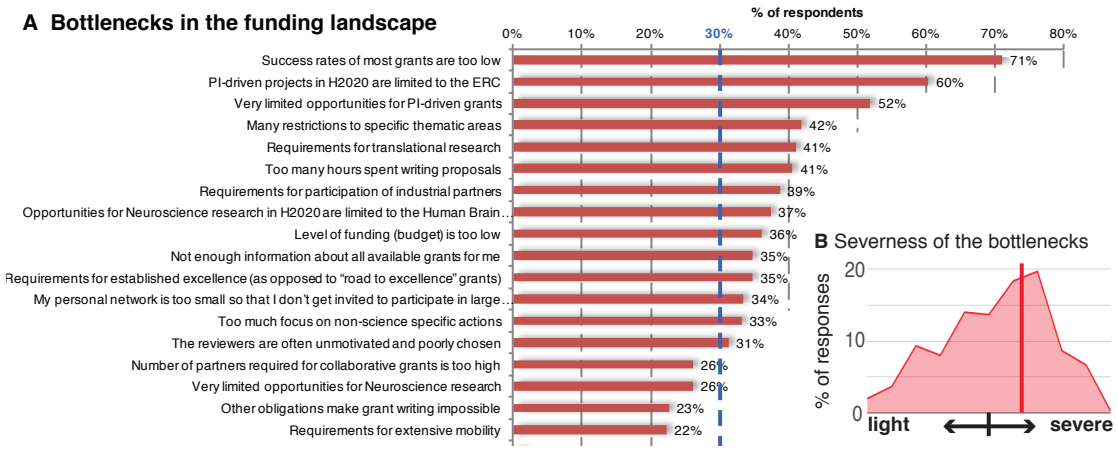

Figure 5: **A** Bottlenecks in current European funding opportunities as seen by early-/mid-career PIs working in Europe. **B** Severity of the bottlenecks.

that "the current funding budget is skewed towards multi-investigator grants" and would welcome a reallocation towards grants that are more suitable for early- and mid career PIs.

Recommendation 2: More funding opportunities for early-career-PIs

When asked to explicitly compare the two funding schemes, our participants stressed the importance of PI-driven grants which massively surpasses that of collaborative schemes (Fig. 6A). Interestingly, the adequacy of both PI-driven and collaborative funding schemes at the EU level was rated as low, echoing the sentiment that even in the relative wealth of collaborative grant schemes, early-stage PIs cannot compete (Fig. 6B).

The preference for PI-driven as opposed to collaborative grants thus also stems from the ability of young/mid-career PIs to secure such grants. As shown in Figure 4, for both male and female respondents, the average success rates for PI-driven grants was significantly higher than collaborative (Co-PI) grants. Rates increased when the respondents were coordinating such grants themselves rather than simply participating in large consortia, but importantly, the average success rates for ERC (StG and CoG) grants was much higher than collaborative grants, despite the highly competitive nature of these funding schemes.

Additionally, it should be noted that - while popular at the Commission level - multi-PI funding schemes come with their own set of difficulties. They often require high levels of management and coordination. On the other hand, true collaborations cannot always be

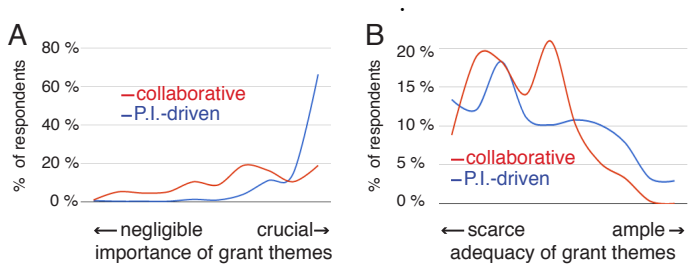

Figure 6: Importance (A) and adequacy (B) of PI driven and collaborative grant schemes. Respondents had to rate grant schemes on a scale from 0 - 10.

forced to emerge among numerous PIs, heading already established labs, each one with a different set of priorities and limited flexibility. More importantly, due to their large budget, the number of such large grants is very small, causing a drop in success rates that often goes below 10% (see also references[1,2]). Finally, restrictions on specific thematic areas, focus on translational research and the number of hours spent on proposal writing with low chances of success are also key negative regulators of European research (Fig. 5).

In summary, our data verify that young European PIs often struggle to support their research through existing schemes that are either too competitive or biased against early career stages. The vast majority of our respondents would welcome more opportunities for early-stage PIs, in the form of PI-driven grants and collaborative calls that favour early stage labs.

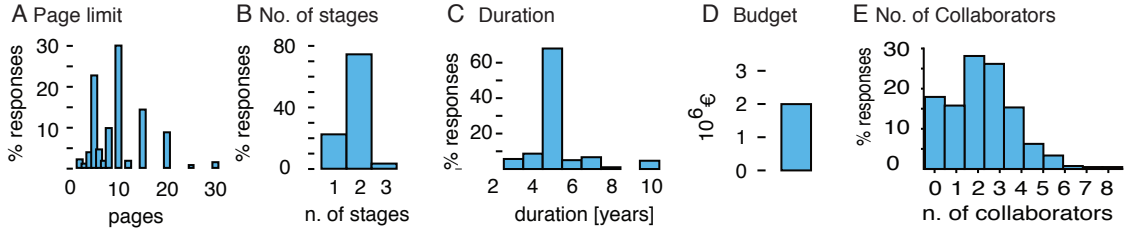

Figure 7: The perfect grant. According to our respondents the perfect grant should have a 2-stage application process (A), a page limit of approximately 5-10 pages (B), a duration of 5 years (C), a budget of about 2 million euro (D) and less than 5 collaborators (E).

The perfect grant (for new PIs)

Naturally, we asked what an early-career European PI would consider to be the perfect grant. The answer was relatively clear (Fig. 7): Most respondents prefer short, concise applications (5-15 pages long, Fig. 7A) with a true 2-stage submission process (Fig. 7B). Grants should have a duration of ∼5 years (Fig. 7C) with a budget of about 2 million euros (Fig. 7D) and a small number of collaborators, averaging 2-3 and not exceeding 5.

These features are reminiscent of ERC and FET (Future Emerging Technologies) funding schemes rather than other types of currently available H2020 grants, suggesting that a revision of H2020 funding schemes towards the proposed direction is needed. Indeed, when responders were asked to name their favourite funding scheme, the ERC ranked at the top Fig. 2A) suggesting that ERC grants can provide a good exemplar basis for revising other H2020 schemes. With respect to FET schemes, survey participants had little knowledge of their existence apart from the Flagship Human Brain Project (Fig. 8). A possible explanation is that respondents were all Neuroscientists while FET schemes were introduced within the Information and Communication Technologies communities (ICT) pillar of prior Framework programmes. These data suggest that FET schemes can also be popular among early-/mid-career scientists, and should be revised and extended to better fit groundbreaking research in life sciences. Additionally, am more aggressive advertisement strategy may prove beneficial to raise awareness of FET opportunities among this important target group.

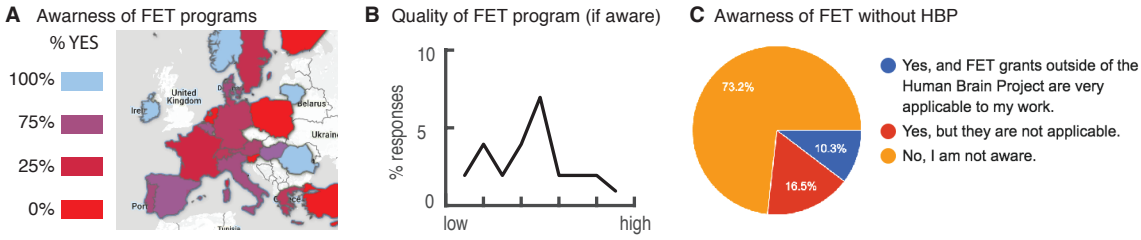

Figure 8: A) Answers to "Are you aware of the FET program (yes/no)", by country. B) If yes to the previous question, how do you rate the quality of the FET program? C) Distribution of answer choices to the question: Are you aware of any funding possibilities outside of the framework of the Human Brain Project?

Recommendation 3: A true two-stage application processes

While ERC funding schemes are both popular and successful among our participant group, our survey also reveals some limitations regarding their application and review process. ERC Starting Grants and Consolidator Grants currently operate a "two-stage" application process that is only truly split into separate stages at the administrative level. For the researchers applying for these awards, the scheme really has only one application stage: applicants must submit, simultaneously, both short (B1) and extended (B2) descriptions of their research plans. Based on initial evaluation of the B1 section alone, only a small percentage (∼30-40% of applications[5,8]) then pass to a full evaluation that assesses the extended B2 research vision. As a result, a significant number of researchers experience demotivation along with a feeling of wasted time and effort on preparing a high quality document that has at least a 50% chance of not being evaluated or even read.

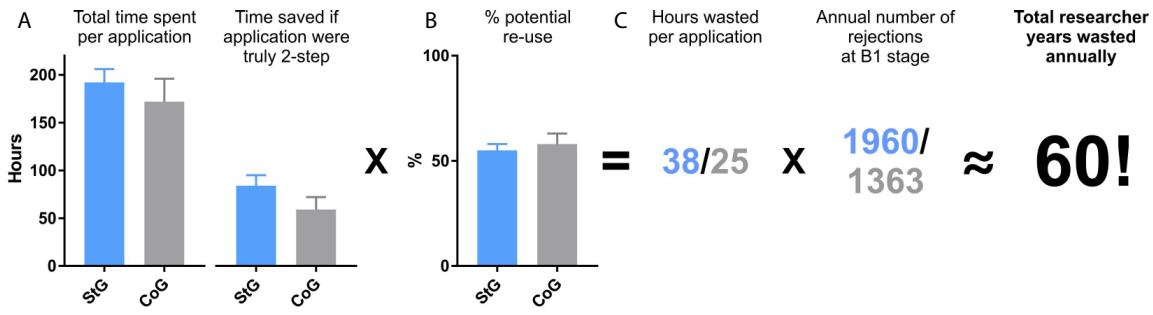

Figure 9: Amount of researcher time that could be saved from a truly two stage ERC application process. A) Hours spent on preparing ERC StG and CoG applications and amount of hours that could be saved if part B2 was not prepared at the first stage. B) percentage of proposal re-use. C) Total researcher years spent annually on preparing ERC B2 applications that are neither evaluated nor re-used.

Our survey gave us the opportunity to quantify the extent of wasted researcher time produced by the current ERC application process (Fig. 9):

- ERC applications take a long time to produce. In our survey, StG applicants spent a mean of 192 hours (= 24 full working days), and CoG applicants 172 hours (22 days) on their proposals.
- We asked directly how much time would have been saved had the application process been truly two-stage. The answer is 'a great deal': 84 hours (∼711 days) on average for StG, and 59 hours (∼7 days) for CoG.
- Since the time spent preparing rejected grants is not necessarily wasted, we asked our respondents to estimate how much of their application could be used elsewhere. The mean percentages - 55 % for StG, 58% for CoG - were then used to adjust the above estimates of time saved by a two-step application.
- Following this correction, the numbers remained high: for every StG application rejected at the B1 stage, **38 hours - a full working week - are essentially wasted preparing a B2 section that is never assessed**. For CoG applications prepared by more experienced and efficient researchers, the numbers are 25 hours, or more than 3 full working days.
- When scaled to the number of StG and CoG applications prepared each year[8–10], the total researcher time wasted as a result of the current ERC application process is staggering. Official statistics from the 2016 StG[9] and 2015 CoG[10] funding rounds,

coupled with an estimated 1:3 chance of success at interview stage, suggest that on average 1960 StG applications and 1363 CoG applications are rejected at the B1 stage every year. This means that, **annually, a grand total of 14,000 researcher hours, or around 62 researcher years, are spent on ERC B2 applications that are not evaluated or re-used**.

Unsurprisingly, our survey uncovered clear support for a true two-stage application process: When asked to state the number of application stages in their "perfect grant", the vast majority (75%, or 229/312) of our respondents favoured 2 stages (Fig. 7A). These findings are very clear: Creating a true 2-stage ERC application process would be very popular, and would save a large amount of researcher time to go towards scientific discovery.

Recommendation 4: Improve reviewer selection and feedback

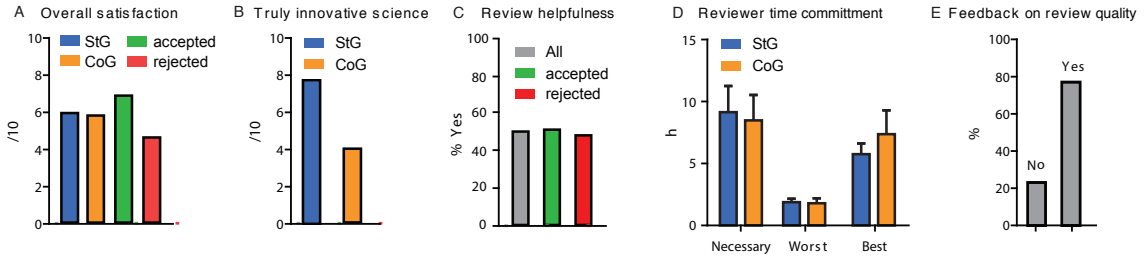

Figure 10: Survey responses on A) overall satisfaction with StG and CoG grant schemes, and B) whether 'truly innovative science' was possible within the framework of ERC grants. Respondents also reported (C) how helpful reviews were and (D) described the expected and perceived time commitment (of the worst and best reviewer), and E) stated whether they thought reviewers should receive feedback and rating by the applicant.

Despite the immense popularity of the ERC funding schemes, respondents reported overall satisfaction levels of ∼60%, well short of 100% (Fig. 10A). This was relatively independent of application outcome (Fig. 10A, red and green bar), and despite the fact that ERC StGs were overwhelmingly reported as enabling "truly innovative science" (Fig. 10B). The lack of a true two step application process contributes to this lack of enthusiasm. Another factor was the low levels of satisfaction regarding the review process of both StG and CoG grants, reported as less than 50%, independent of application outcome. (Fig. 10C). One reason for these low ratings may be the perceived low amount of time reviewers spend on individual grants. In fact, respondents homogeneously reported that they expected the worst of their reviewers to have spent less than 20% of the time necessary to fully grasp their application, and even the "best reviewer" was thought to have spent no more than 75% of the necessary time on an application (Fig. 10D). In the comments section, multiple

entries additionally reported a (perceived) lack of expertise in the field of an application. This perception, coupled with the large effort spent on an individual application, can be demoralising to individual researchers. Worse, it can have serious consequences for the ERC if qualified applicants decide to forgo an application on the perception that the assessment of applications is based as much on chance as it is on merit. Consequently, more than 80% of respondents approved of measures to collect and use feedback on the reviewers themselves as a measure to increase review quality.

While we recognise that our proposal presents complex and far-reaching challenges on the practical side of data collection and reviewer privacy, the ongoing specialisation of subfields will likely further escalate the above issues. We urge the ERC to consider implementing 3 simple steps that can alleviate some of the immense challenges in finding and selecting an adequate body of reviewers: Firstly (1), create large panels of experts within each field, who will nominate reviewers for each application and simplify the assimilation of new reviewers into the system. This will ensure a better fit between the application and the expertise of the reviwer. Second (2), use identical reviewers for (the adapted (see above), truly separate) stages 1 and 2, and pay them for their work on both stages. Keeping the reviewers identical for both stages will ensure higher consistency, and a bigger moral obligation by the reviewer to act responsibly. Finally, 3) we would urge the creation of a feedback system to collect and use applicants' feedback on the reviews to ensure a consistently high quality of reviewers. Over time this will purge under-motivated reviewers from the system.

Conclusion

From the perspective of early-/mid-career scientists, the current funding situation in Europe is facing a number of challenges, ranging from a serious drop in success rates of funded applications[6,7], to administrative and basic design issues in its various funding instruments. We have used the responses of over 300 early-/mid-career Neuroscientists in a custom-made Europe-wide survey to identify both success stories and bottlenecks so as to propose concrete actions that can reverse these shortcomings. Our findings indicate the need for a) ensuring better gender equality in the funding system via the implementation of specific measures, b) providing more funding opportunities for early-/mid-career scientists via increasing the number of PI-driven grants and tailoring collaborative grants to account for career-stage differences among early vs. established applicants, c) establishing a true two-stage application process for ERC grants, thus saving hundreds of researcher hours and resulting in great benefits for both research and innovation and d) improving the review process of ERC, and possibly other types of two-stage funding schemes within H2020. We believe our suggestions, substantiated by our data, are relatively easy to implement and can significantly improve the funding opportunities within H2020, with a special focus on European early- and mid-career PIs, the main drivers of research and innovation in Europe.

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