Policy Brief

Recommendations from the Research Council of Norway's International Advisory Board
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Stepping up funding of high-risk/ high-gain research

High-risk/high-gain research can lead to significant advances in knowledge, radical innovations and breakthrough solutions to societal problems beyond what more incremental research approaches can achieve. However, there is evidence that highly novel research is more challenging to carry out, publish and fund. To counteract this bias, there is on the one hand a need to introduce measures designed to reduce bias against high-risk/high-gain research in career and funding mechanisms on a general level, and on the other hand, dedicated funding mechanisms for high-risk/high-gain research are needed.

There are indications that both research funding and career promotion mechanisms have a novelty bias, in part due to their reliance on bibliometric indicators which have been found to be biased against high-risk/high-gain research (Wang et al., 2017). Since the 1950s, both firms and academic researchers have narrowed the scope of their research and innovation efforts, preferring safer rather than more novel innovations (Lee, 2015; Strumsky et al., 2011). This is a worrying trend. If the research endeavour and the processes designed to support it become too conservative and encourage only incremental advances, a country's longer-term ability to compete economically, to harness science

for solving national and global challenges, and to contribute to the progress of science as a whole is at risk (Century, 2007).

For high-risk/high-gain research, implicitly the gains sought fall into three categories: scientific impacts, economic impacts and societal impacts, achieved through the translation of new knowledge or technologies to solve societal challenges (OECD, 2021). The risks are associated with the uncertainty of the outcomes of research - potentially leading to exceptional results, but also to no results (Franzoni et al., 2021) and/or that the research is carried out in an unconventional and thus more risky manner.

In line with this, the US National Institutes for Health (NIH) define high-risk, high-gain research as research involving "ideas that have the potential for high impact, but that may be too novel, span too diverse a range of disciplines, or be at a too early stage to fare well in the traditional peer review process."

To lower the bar for carrying out high risk/high gain research, RCNs International Advisory Board recommends:

- Experiment with adjustments in standard evaluation mechanisms to counteract bias against high-risk/high gain research
- Experiment with funding mechanisms targeting high-risk/high gain research
- Develop a better knowledge base on how to review and fund high-risk/high-gain research

Experiment with adjustments in standard evaluation mechanisms to counteract bias against high-risk/high-gain research

An overriding challenge for stepping up funding of highly novel research through conventional funding arenas, is the conservative nature of peer review. Numerous studies document this novelty bias. Boudreau et al. (2016), studying research grant proposal evaluation at a leading medical research university found that "evaluators uniformly and systematically give lower scores to proposals with increasing novelty." (p. 3). Similar findings are reported in studies of peer review in funding agencies (Ayoubi et al., 2021; Lanoë, 2018; Veugelers et al., 2019), including grant peer review at the RCN (Langfeldt, 2006).

Targeted efforts tilting the competition in favour of more novel research endeavours are thus needed in order to create a more level playing field for incremental and highly novel proposals alike. The Norwegian government, RCN and

Norwegian research institutions should work together to create a research and innovation system more accommodating of highly novel research.

Compose diverse panels, educate them on the novelty bias and limit their workload

RCN and Norwegian research institutions should take care to construct evaluation panels that are able and willing to select novel research proposals and highly creative candidates. Research in social psychology finds that giving explicit selection criteria and panel instructions that emphasis originality, improve panels' ability to select original ideas (Rietzschel et al., 2010, 2014), albeit at the expense of member satisfaction with the ideas selected. Educating panels to create greater understanding of resource allocation goals and their own cognitive limits has furthermore been suggested as a plausible avenue to address the novelty bias (Boudreau et al., 2016).

In terms of composition, panels should be diverse, as groups with high expertise diversity have been found to prefer more original ideas (Criscuolo et al., 2017a). Panellists should preferably have a track record of carrying out novel research, as people who are good at generating original ideas are also better at recognising originality (Rietzschel et al., 2019). Workloads should be manageable, and panellists should be given ample time to discuss, as groups' "undeniable disdain for risky and original ideas" (Blair & Mumford, 2007, p. 215) is strengthened under time pressure and with high workloads (Criscuolo et al., 2017a).

Accelerate implementation of the DORA declaration in evaluation processes

As discussed, bibliometric indicators are biased against highly novel research. Novel papers are less likely to be published in high impact factor

journals and take more time to become top-cited (figure 1) (Wang et al., 2017). Several studies (Bhattacharya & Packalen, 2020; Gold, 2021) point to such indicators as the culprit explaining a move to incrementalism in science, "away from exploratory projects that are more likely to fail, but which are the fuel for future breakthroughs." (Bhattacharya & Packalen, 2020, p. 1). RCN and Norwegian research institutions must work together to accelerate the move away from such indicators in evaluation and promotion mechanisms.

Figure 1:

Novelty needs time
Highly original papers are more likely to be highly cited after three or more years.
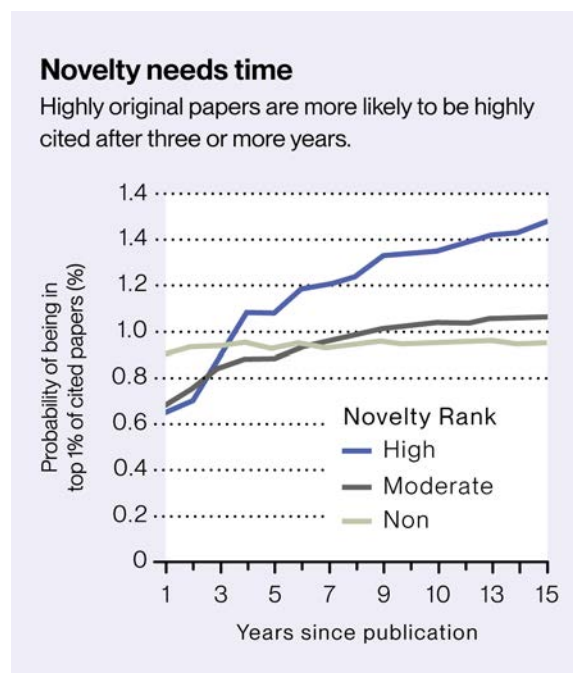
RCN has signed the DORA declaration and instructs its panels to disregard Journal Impact Factors and other bibliometric indicators, but provide limited guidelines to experts on which alternative approaches to take and which alternative measures to use. Work to further enable the uptake of the DORA declaration should be accelerated, collecting inspiration from international good practice. For example, funding agencies in the UK, Netherlands and

Luxembourg are now abandoning traditional CVs focused on publications in favour of CV formats that emphasize quality over quantity, and which include narratives about broader impact.

Equally, Norwegian research institutions should work actively to ensure tenure and promotion policies are not unduly focused on publication indices, drawing on relevant international initiatives. For example, an ERA initiative aimed at establishing a European agreement for a reformed research assessment system was recently established, and several good practice examples exist internationally.

RCN could assist the institutions in their work towards DORA compliance and encouragement of high-risk/high-gain research through an explicit focus on this in the set-up of their scheme for evaluation of Norwegian research. Here, the Dutch Protocol for Research Assessment could serve as inspiration. It was revised in 2020 to shift away from traditional indicators and as a recent OECD rapport asserts (OECD, 2021), this shift in assessment can be expected to have a positive impact on high-risk/high-reward research.

Establish a standing RCN evaluation panel for radically interdisciplinary research proposals
While it is not possible to ascertain the novelty of a project proposal prior to evaluation by peers, it is possible to ascertain the degree of inter-disciplinarity. Naturally, not all interdisciplinary research is high-risk/high-reward, but a range of empirical and theoretical contributions document that novel research tend to recombine and reconfigure knowledge in unprecedented ways (Criscuolo et al., 2017b). Implementing evaluation measures particularly targeting radically inter-disciplinary proposals could thus be one possible avenue for reducing the novelty bias in proposal assessment. In the same way as grant peer

review has been found to discriminate against highly novel applications, it has also been found to disfavour radically interdisciplinary research: "The greater the degree of interdisciplinarity, the lower the probability of being funded" (Bromham et al., 2016). Establishing a dedicated evaluation panel for radically interdisciplinary proposals might serve to address this bias, as such proposals have trouble finding an appropriate home in RCNs moderately disciplinary evaluation panels.

Unlike RCNs traditional evaluation panels, the panel should be a standing panel rather than ad-hoc, to encourage both higher efficiency and higher quality. Composing a panel adept at evaluating radically interdisciplinary research proposals will be more demanding and time-consuming than constructing traditional evaluation panels. Furthermore, in terms of quality, inter-disciplinary research assessment is a continuous learning exercise due to the need to develop a common language, a common understanding of different disciplinary perspectives and a common understanding of how interdisciplinarity should be defined and evaluated, meaning "learning by doing" - over a longer period of time, is more important for assessors of radically inter-disciplinary proposals than monodisciplinary/ moderately interdisciplinary proposals.

Ensure more active portfolio management by RCN portfolio boards

Managing at the portfolio level can enable more risk-taking as it allows safer investments to be balanced against riskier ones and impacts from successful projects to be balanced against less successful projects. Through its 16 portfolio boards, RNC has the infrastructure in place to carry out the risk-based portfolio management necessary to step up funding of high-risk/ high-gain research.

Initial steps laying the basis for more active risk-based portfolio management has already been taken. From 2022 onwards, the excellence criteria for Researcher Projects will be subdivided into two separate scores – one for originality / innovative research and one for solidity/robustness, allowing portfolio boards to curate a portfolio of funded researcher projects that score high on originality. This is warranted, as studies show high novelty to be conceptually tied to weaker evaluations of solidity (Lee, 2015). Furthermore, the use of less fine-grained scoring systems could be trialled, as this would lead to more ties between research proposals and thus greater scope for active priority-based portfolio management.

The strategy of identifying proposals that score high on originality and prioritizing these for funding could be complemented with a system identifying those proposals for which there is substantial disagreement among evaluators and funding these, based on the assumption that high-risk/high-gain proposals will be subject to more controversy than safer proposals. The US National Institutes of Health use such an "out of order funding" approach, awarding funding for a number of applications that fall below the funding line, but that meets certain criteria, such as being high-risk/high-gain.

The portfolio board for Industry and Service has already declared ambitions of a risk-based portfolio approach, stating that 10% of funding in their field of responsibility will be dedicated to radical innovation. The other portfolio boards should follow suit and set clear targets for the proportion of high-risk/high-gain research and innovation in their respective portfolios.

Ensure acceptable success rates in funding competitions

A challenge in RCNs attempts to fund high-risk/high-gain research through its normal funding arenas are its low success rates. FRIPRO, the primary instrument aimed at transformative research, has routinely had a success rate around 10%. Langfeldt (2001), based on observations of RCN evaluation panels, sets forth the hypothesis that "tight budgets [...] tend to strengthen established research and give less pluralism in funded research."

Adjustments to the peer review process along the lines outlined above is thus expected to have marginal effect if success rates are exceedingly low. If RCN is to succeed in improving funding for high- risk/high-gain research, improving the funding situation for its competition arenas is paramount. Political support for risk-taking and investment in long term research is critical if efforts aimed at tilting the balance towards increased funding of highly novel research is to succeed.

This should be coupled with measures aimed at reducing the number of applications submitted. In a first instance, non-restrictive approaches should be trialled. Eliminating application deadlines is one non-restrictive approach that has proven effective, with for example the US National Science Foundation's biology directorate experiencing more than a 50% drop in applications in the decade since they eliminated fixed deadlines (Mervis, 2022). Applications are processed in a flexible manner when a sufficient number has been received, and staff use their knowledge of their portfolio, including historical and projected demand, to estimate the budget needed for each pool of applications processed. The investments across different panels are a function of the quality of the proposals, the level of demand and availability of funds.

Ensure flexible follow up of grantees

There is evidence that flexibility in funding is an important precondition for encouraging highly novel research. Flexibility means that fund-holders are free to make high-risk /high-potential invest-ments and have the opportunity to address new issues and ideas that arise (Heinze, 2008, 2013). In line with this, RCN should strive for high flexibility in its awards, allowing for easy adjustments of the project plan and deliverables as the project unfolds.

Peer review tends to be conservative and risk-averse, biased in favour of incremental projects. There is thus a need to experiment with adjustments in standard career and funding mechanisms to counteract bias against high-risk research.

IAB recommends that RCN should:

- Establish a standing RCN evaluation panel for radically interdisciplinary research proposals.
  The panel should feature a broad selection of experts from a multitude of fields, with a proven track record in carrying out innovative/interdisciplinary research.
- Ensure more active portfolio management by RCN portfolio boards.
  Set clear targets for the proportion of high-risk/high-gain research and innovation in the boards' portfolios, and curate a portfolio of projects that score high on originality and/or projects where there is substantial disagreement among evaluators.
- Ensure flexible follow up of RCN grantees.
  Allow for easy redirection of funds to pursue unforeseen high-potential ideas .

IAB recommends that RCN and research institutions should:

- Compose diverse evaluation panels, educate them on the novelty bias and limit their workload.

Ensure panels are able and willing to select novel research proposals and highly creative candidates.
- Accelerate implementation of the DORA declaration in evaluation processes.
  Ensure funding competitions and tenure and promotion policies are not unduly focused on publications and publication indices, drawing inspiration from relevant international initiatives.

IAB recommends that RCN and the Government should:

- Ensure acceptable success rates in funding competitions.
  Political support for risk-taking and investment in long term research is critical if efforts aimed at tilting the balance towards increased funding of highly novel research is to succeed. Tight budgets tend to strengthen established research over more experimental and risky research. RCN and the Government should work together to ensure acceptable success rates through a two-pronged approach of improving funding of RCNs competition areas and introducing targeted measures to reduce the number of applications received.

Experiment with funding mechanisms targeting high-risk/high-gain research

Given the innovation bias inherent to peer review, dedicated funding mechanisms for high-risk research has become increasingly common internationally, so also in RCN, including schemes such as Radical frontier Researcher Project, Large-scale Interdisciplinary Researcher Projects and Idélab. However, RCNs current portfolio of funding mechanisms aimed a high-risk/high-gain research are all project-based awards.

Establish an RCN funding mechanism for individual researchers with high-risk/high-gain ideas

The US National Science Board (2007) finds in its survey of support for transformative research that the more successful of these programs focus more on the individuals who apply than the projects themselves. Azoulay et al. (2011) conducted a comprehensive study comparing two programs representing the two categories of individual support (Howard Hughes Medical Institute Investigator Program) and project support (National Institutes of Health R01 Grants) and they too conclude that the former is better suited to support highly novel research. Likewise, OECD (2021) in its review of funding instruments for high-risk/high gain research find that project-based funding may discourage risk taking.

In line with this, RCN should supplement its current portfolio of project-based awards with a funding mechanism providing people-based awards with considerable flexibility in the use of awarded funds. Naturally, while the selection mechanism should focus on the individual applicant, the funds distributed should enable successful applicants to build appropriate research teams. HHMI is a pioneer in supporting "people not projects", and other funding schemes such as the National Institutes of Health's Pioneer Award has emulated its people-based funding approach. RCN could draw inspiration from this and similar funding schemes internationally in constructing a people-based funding mechanism.

Establish institutional funding mechanisms for high-risk/high-gain research

Some universities and research providers have established internal funding schemes to specifically support research projects that may be too risky for national funding agencies to support. For example, several US universities use internal funds to seed teams for preliminary de-risking research on high-risk research ideas (OECD, 2021). In an international perspective, Norwegian universities have a high level of core funding, and should consider establishing dedicated funding mechanisms for such de-risking of research ideas.

Furthermore, universities could consider how they can draw more effectively on the considerable work that carried out by RCNs evaluation panels in order to identify talents and support these on their own account. NTNUs Star program is a very good example in this respect. The programme aims to support young research talents and identifies candidates for inclusion in the programme based on the results of RCNs evaluation of Researcher projects.

IAB recommends that RCN should:

- Establish a funding mechanism for individual researchers with high-risk/high-gain ideas. High-risk/high-gain funding schemes that focus more on the individuals who apply than the projects themselves are more successful in identifying and funding transformative research.

IAB recommends that research institutions should:

- Establish institutional funding mechanisms for high-risk/high-gain research. Such funding should support preliminary de-risking research on high-risk research ideas, to enable funding through national and international funding schemes in a next stage. Additionally, research institutions should draw on external funding schemes in order to identify talents and support these on their own account.

Develop a better knowledge base on how to review and fund high-risk/high-gain research

While this policy brief offers some recommendations on potential avenues for improving support for high-risk/high-gain research, the knowledge base for how such research can best be identified and supported is limited. There is a great need for experimental approaches to test alternative research funding designs, and to document these experiments appropriately. In this respect, it is commendable that RCN is a member of the Research on Research Institute which aims to improve how research is funded, practised, communicated and evaluated. RCN should contribute actively to such exchange of experience by consistently evaluating in a rigorous manner its experiments in funding high-risk/high-gain research, and in the longer term also the impact of such schemes – does high-risk projects in fact produce high-gain?

In addition to such exchange of experiences, RCN should take steps to improve collection, analysis, reporting, and accessibility of data about their funding instruments. Making data available for research in this way could serve to strengthen the currently meagre knowledge base in the field. To further boost the build-up of knowledge on how to best support high-risk/high-gain research, RCN should earmark funding for research on the subject.

The knowledge base for how high risk/high gain research can best be identified and supported is limited and targeted action to improve it is necessary.

Recommendations:
- Actively experiment with funding mechanisms aimed at supporting high-risk/high-gain research and evaluate such experiments rigorously.
- Improve collection, analysis, reporting, and accessibility of data on funding instruments.
- Support research on how to best identify, evaluate, fund and follow-up high-risk/high-gain research.

References

Ayoubi, C., Pezzoni, M., & Visentin, F. (2021). Does It Pay to Do Novel Science? The Selectivity Patterns in Science Funding. Science and Public Policy, 48(5), 635-648. https://doi.org/10.1093/scipol/scab031

Azoulay, P., Graff Zivin, J. S., & Manso, G. (2011). Incentives and creativity: evidence from the academic life sciences. The RAND Journal of Economics, 42(3), 527-554.

Bhattacharya, J., & Packalen, M. (2020). Stagnation and scientific incentives.

Blair, C. S., & Mumford, M. D. (2007). Errors in idea evaluation: Preference for the unoriginal? The Journal of Creative Behavior, 41(3), 197-222.

Board, N. S. (2007). Enhancing support of transformative research at the National Science Foundation. National Science Foundation.

Boudreau, K. J., Guinan, E. C., Lakhani, K. R., & Riedl, C. (2016). Looking Across and Looking Beyond the Knowledge Frontier: Intellectual Distance, Novelty, and Resource Allocation in Science. Management Science, 62(10), 2765-2783. https://doi.org/10.1287/mnsc.2015.2285

Bromham, L., Dinnage, R., & Hua, X. (2016). Interdisciplinary research has consistently lower funding success. Nature, 534(7609), 684-687. Century, C. o. P. i. t. G. E. o. t. s. (2007). Rising above the gathering storm: Energizing and employing America for a brighter economic future. National Academies Press Washington, DC.

Criscuolo, P., Dahlander, L., Grohsjean, T., & Salter, A. (2017a). Evaluating novelty: The role of panels in the selection of R&D projects. Academy of Management Journal, 60(2), 433-460.

Criscuolo, P., Dahlander, L., Grohsjean, T., & Salter, A. J. (2017b). Evaluating novelty: the role of panels in the selection of R&D projects. Academy of Management Journal, 60, 433-460.

Franzoni, C., Stephan, P., & Veugelers, R. (2021). Funding risky research.

Gold, E. R. (2021). The fall of the innovation empire and its possible rise through open science. Research Policy, 50(5), 104226. https://doi.org/10.1016/j.respol.2021.104226

Heinze, T. (2008). How to sponsor ground-breaking research: a comparison of funding schemes. Science and Public Policy, 35(5), 302-318.

Heinze, T. (2013). Creative accomplishments in science: definition, theoretical considerations, examples from science history, and bibliometric findings. Scientometrics, 95(3), 927-940.

Langfeldt, L. (2001). The decision-making constraints and processes of grant peer review, and their effects on the review outcome. Social Studies of Science, 31(6), 820-841.

Langfeldt, L. (2006). The policy challenges of peer review: managing bias, conflict of interests and interdisciplinary assessments. Research Evaluation, 15(1), 31-41. https://doi.org/10.3152/147154406781776039

Lanoë, M. (2018). The evaluation of competitive research funding:. an application to French programs Bordeaux].

Lee, C. J. (2015). Commensuration bias in peer review. Philosophy of Science, 82(5), 1272-1283.

Mervis, J. (2022). Odds for winning NSF grants improve as competition eases. Science, 376(6594), 684. https://doi.org/https://doi.org/10.1126/science.adc9452

OECD. (2021). Effective policies to foster high-risk/high-reward research. https://doi.org/doi:https://doi.org/10.1787/06913b3b-en

Rietzschel, E. F., Nijstad, B. A., & Stroebe, W. (2010). The selection of creative ideas after individual idea generation: Choosing between creativity and impact. British journal of psychology, 101(1), 47-68.

Rietzschel, E. F., Nijstad, B. A., & Stroebe, W. (2014). Effects of problem scope and creativity instructions on idea generation and selection. Creativity Research Journal, 26(2), 185-191.

Rietzschel, E. F., Nijstad, B. A., & Stroebe, W. (2019). Why great ideas are often overlooked. The Oxford handbook of group creativity and innovation, 179-197.

Strumsky, D., Lobo, J., & Van der Leeuw, S. (2011). Measuring the relative importance of reusing, recombining and creating technologies in the process of invention. In SFI Working Paper 2011-02–003: 23.

Wang, J., Veugelers, R., & Stephan, P. (2017). Bias against novelty in science: A cautionary tale for users of bibliometric indicators. Research Policy, 46(8), 1416-1436.

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