RAND EUROPE

CHILDREN AND FAMILIES
EDUCATION AND THE ARTS
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INFRASTRUCTURE AND TRANSPORTATION
INTERNATIONAL AFFAIRS
LAW AND BUSINESS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
TERRORISM AND HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Skip all front matter: Jump to Page 1

Support RAND

Browse Reports & Bookstore

Make a charitable contribution

For More Information

Visit RAND at www.rand.org

Explore RAND Europe

View document details

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND Web site is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see RAND Permissions.

This report is part of the RAND Corporation research report series. RAND reports present research findings and objective analysis that address the challenges facing the public and private sectors. All RAND reports undergo rigorous peer review to ensure high standards for research quality and objectivity.

Alternatives to Peer Review in Research Project Funding

2013 UPDATE

Susan Guthrie, Benoît Guérin, Helen Wu, Sharif Ismail, and Steven Wooding

RAND EUROPE

RR–139-DH
April 2013
Prepared for the UK Department of Health-funded Centre for Policy Research in Science and Medicine (PRiSM)

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2013 RAND Corporation

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (http://www.rand.org/publications/permissions.html).

Published 2013 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: http://www.rand.org

To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Preface

This pack provides an overview of a number of alternatives to peer review for assessing research funding applications, and is an update and extension of RAND Europe's 2011 report on *Alternatives to Peer Review in Research Project Funding* (TR-1010-DH). It is intended to be used as a tool by research funders to help them develop the most appropriate approach for funding their specific research needs. This update includes a new framework for considering peer review and six new examples of possible alternatives to specific aspects of the peer review approach: unconstrained excellence, conditional funding, mentored, scoring, online/iterative and random.

This document has been produced by RAND Europe's Department of Health-funded Policy Research in Science and Medicine (PRiSM) research unit. PRiSM aims to provide research, analysis and advice to support the effective implementation of the Department of Health's 'Best Research for Best Health' strategy, and to improve research to support decisionmaking more widely in the health research sector. This is an independent report commissioned and funded by the Policy Research Programme in the Department of Health. The views expressed are not necessarily those of the Department.

RAND Europe is an independent not-for-profit policy research institute that is part of the RAND Corporation. We share a mission to improve policy and decisionmaking through objective research and analysis. RAND Europe's clients include European governments, institutions, NGOs and firms with a need for rigorous, independent, multidisciplinary analysis. This report has been peer reviewed in accordance with RAND's quality assurance standards.

For more information about RAND Europe or this document, please contact:

Steven Wooding
RAND Europe
Westbrook Centre
Milton Road
Cambridge CB4 1YG
United Kingdom
Tel: +44 (1223) 353 329
Email: wooding@rand.org or reinfo@rand.org

Summary

Peer review is often considered the gold standard for reviewing research proposals. However, it is not always the best methodology for every research funding process. Public and private funders that support research as wide-ranging as basic science, defence technology and social science use a diverse set of strategies to advance knowledge in their respective fields. This report highlights a range of approaches that offer alternatives to, or modifications of, traditional peer review – alternatives that address many of the shortcomings in peer review effectiveness and efficiency. The appropriateness of these different approaches will depend on the funder's organisational structure and mission, the type of research they wish to fund, as well as short- and long-term financial constraints.

We hope that the information presented in this pack of cards will inspire experimentation amongst research funders by showing how the research funding process can be changed, and give funders the confidence to try novel methods by explaining where and how similar approaches have been used previously. We encourage funders to be as inquisitive about their funding systems as they are about the research they support and make changes in ways that can be subsequently evaluated, for instance using randomised controlled trials.[1] Such an approach would allow researchers to learn more about the effects of different methods of funding and, over time, to improve their knowledge of the most effective ways to support research.

[1] Azoulay, P., "Turn the scientific method on ourselves," *Nature*, Vol. 484, 2012, pp. 31–32.

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Introduction

Peer review is often the standard by which research proposals are evaluated when making project funding decisions. Despite its widespread use for judging the merit of proposed research, the shortcomings of peer review, notably in terms of efficiency and effectiveness, are well documented (see Table 1).

Table 1: Summary of the major criticisms of grant peer review and our assessment of the strength of the evidence base supporting them.

Evaluation question	General critique	Particular criticism(s)	Is the criticism valid?	Strength of the evidence base (1 = weak; 5 = strong)
Is peer review an efficient system for awarding grants?	Peer review is an inefficient way of distributing research funding	High bureaucratic burden on individuals	Unclear	2
		High cost	Yes	4
		Doubtful long-term sustainability	Unclear	2
Is peer review an effective system for awarding grants?	Peer review does not fund the best science	It is anti-innovation	Unclear	2
		It does not reward interdisciplinary work	Unclear	2
		It does not reward translational/applied research	Unclear	2
	Peer review is unreliable	Ratings vary considerable between reviewers	Yes	4
	Peer review is unfair	It is gender-biased	Unclear	3
		It is age-biased	No	4
		It is biased by cognitive particularism	Unclear	3
		It is open to cronyism	Unclear	3
	Peer review is not accountable	Review anonymity reduces transparency	Yes	4
	Peer review is not timely	It slows down the grant award process	Unclear	2
	Peer review does not have the confidence of key stakeholders		No	4

Source: Ismail, Farrands and Wooding, 2009, p. 10.

Following on from RAND Europe's 2009 report, *Evaluating Grant Peer Review in Health Sciences – A Review of the Literature*,[2] which summarises major perceived shortcomings of the peer review process, this document highlights a set of variations from, and alternatives to, the traditional peer review model. Our aim is to inspire thinking and experimentation amongst research funders by showing how the review process can be changed and highlighting where and what alternative approaches have been used. We do not suggest replacing peer review completely, as it probably remains the best method for review of grant applications in many situations, nor do we suggest that any one of the methods covered in the pack will be appropriate for all types of research. Rather, we hope that by considering some of the alternatives to peer review, research funders will be able to support a wider portfolio of projects, which may lead to more innovative, higher-impact work.

ORGANISING ALTERNATIVES TO PEER REVIEW

In this section we present a three-phase model of the science funding process: a development phase for research questions and proposals; a selection phase where the most promising proposals are selected; and finally a research phase in which the research is carried out (Figure 1). In the pack we consider how elements of a traditional peer review process might be modified by funders.

Each phase can be further subdivided. The development phase involves the funder defining the overall scope of the funding programme; the researchers generating questions to be researched; the funder harvesting those proposals; and the researchers refining their research proposals. Although we present this as a simple linear process, these steps can occur in a different order, or blur together: for example, the funder might work with the researchers to develop and refine promising proposals.

In the selection phase the funder selects what they consider to be the most promising proposals. In this case the phase can be subdivided by considering different characteristics of the selection process: who carries out the selection, what criteria are used to judge the research proposals and how they combine their judgements to reach a decision.

Each of the options outlined in this pack describes a possible way in which one of these key elements of peer review can be changed, and the impact that this change may have on the decisionmaking process for funding. The standard approach in the traditional model of peer review and the alternatives that make up our options are summarised in Table 2 below.

The options presented are not intended as prescriptive methodologies, rather as illustrative examples. Nor are they mutually exclusive: different approaches may be combined to produce the most appropriate funding system for a particular funder. In this pack we focus on project-specific funding decisions rather than individual/institutional block grants, although much of the learning is transferrable. Our focus is on general features of the process rather than characteristics that might be specific to a particular funder or type of funding body. This should allow the findings to be more widely applicable, allowing any interested research funding organisation to consider how it could modify its processes to incorporate some of the approaches.

[2] Ismail, S., A. Farrands, and S. Wooding, *Evaluating Grant Peer Review in the Health Sciences – A review of the literature*, Santa Monica, Calif.: RAND Corporation, TR-742-DH, 2009.

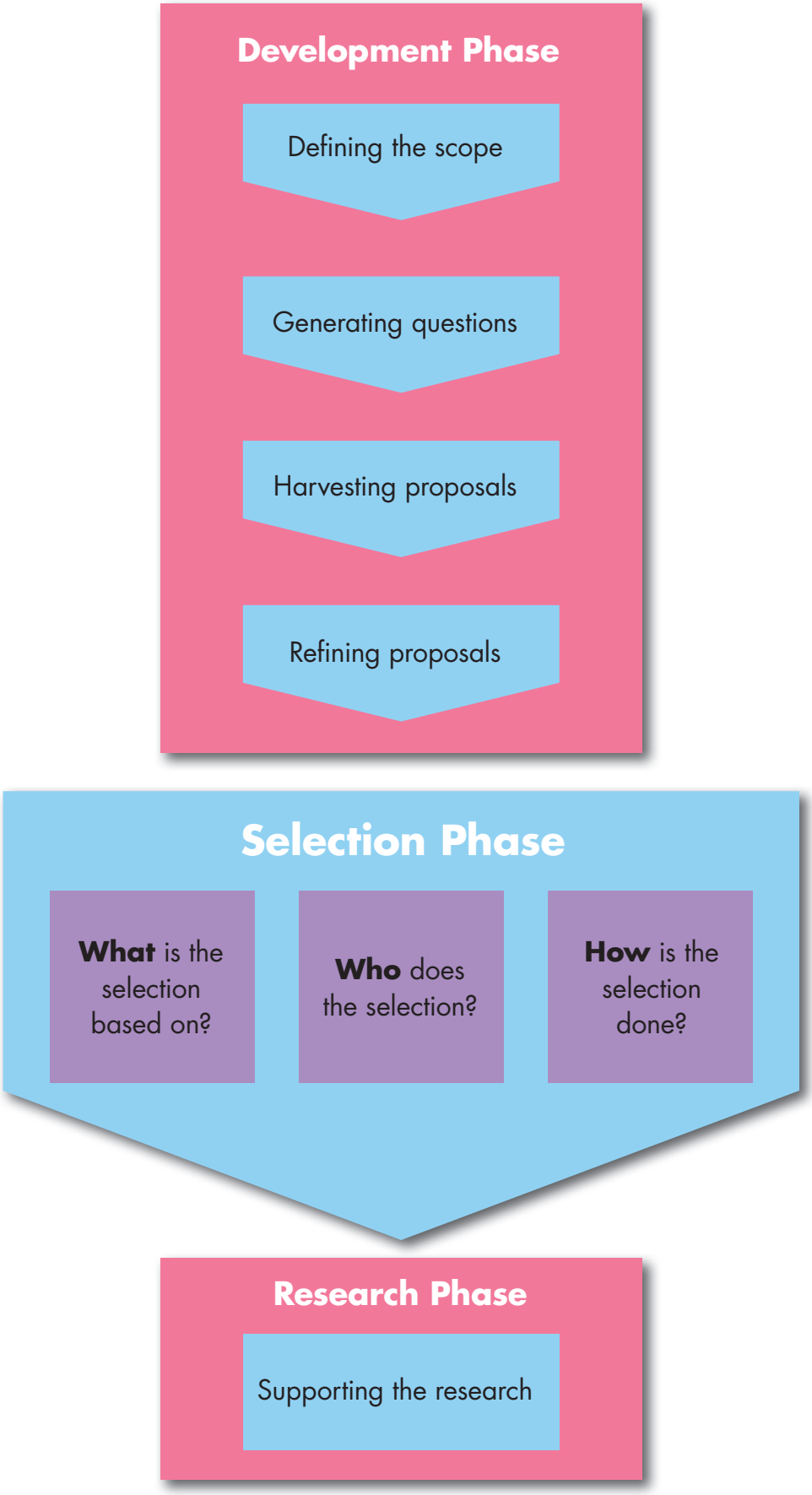


Figure 1: An overview of the science funding process.

Table 2: Overview of alternatives to peer review presented in order of the stages in the research funding process.

Traditional peer review model	Examples of alternative approaches
Stage 1: Defining the scope	
Strategic programme planning: The funding organisation decides on a broad set of research priorities before allocating a fixed amount of resources to each programme area.	*Milestones*: The funder breaks up big challenges, such as developing a cure for a disease, into a road map of smaller questions. Researchers then compete to answer these smaller questions. This allows a strategic, stepwise approach, and easier judgement of whether particular research aligns with the funder's aims; but success in achieving research objectives relies on the accuracy of the road map. *Unconstrained excellence:* Instead of deciding on specific research priorities, the funder directs resources based on the excellence of the researcher, who is then free to pursue his/her interests.
Stage 2: Generating questions	
Isolated applicants: Applicants submit research proposals to the funding body that have been developed alone or in teams.	*Sandpit:* Researchers and a diverse group of experts come together for a workshop. Through brainstorming sessions and interactive collaboration, researchers refine ideas. At the end of the workshop, funding is awarded to the best proposal. This process fosters transparent peer review and encourages substantive changes to improve the proposed research.
Stage 3: Harvesting proposals	
Passive call for funding: The funding body releases a call for proposals so that applicants can submit applications by a specific deadline.	*Proactive call:* The funding body goes out and 'beats the bushes' to generate interest and proposals, interacting with researchers and teams to ask them to submit applications. A proposal may be developed with the help of a team from the funding body before it is submitted for peer review. The Venture Research programme run by British Petroleum, described on the Mentored card, provides an example of this type of programme.
Stage 4. Refining proposals	
Resubmission in case of failure: The applicant refines a failed proposal, and may resubmit it during a later call for funding.	*Conditional funding:* Money is awarded, but is conditional on changes and developments suggested by the funding body. The funder works with the research team to improve the proposed work programme before the start of the project. *Mentored*: All applications are mentored by the funding body early on, before being submitted for peer review. This method differs from conditional funding, which only mentors applications that have already been pre-selected.

Traditional peer review model	Examples of alternative approaches
Stage 5a. What is the selection based on?	
Ex-ante: Research outcomes and expected deliverables are *prospectively* defined in project proposals.	*Portfolio:* Funds are allocated with a balanced risk approach, rather than by topic. Riskier projects with uncertain outcomes, but which may be ground-breaking, are more likely to be funded in this way because funders can balance them with awards to conservative projects with predictable outcomes. *Ad hoc/discretionary:* The funder sets aside a portion of funds to be allocated to projects that fall outside the normal boundaries of their programmes but may be worthwhile exceptions. Ad hoc decisions allow funders to respond rapidly to urgent questions and emerging issues, and can also support cross-cutting, interdisciplinary research that is difficult to justify within a single programme area. *Ex-post awards/prizes*: When the funding body wants to achieve a specific goal, it may award funding only after the outcome is demonstrated. The financial risk is shifted from funders to researchers, providing assurance that the funders' goals will be achieved if the challenge is solved. *Renewal:* Renewal takes into account differences in focus associated with short-term versus long-term funding agreements. Funding renewals combine an opportunity for undertaking research with longer-term vision with a mechanism that holds researchers accountable for progress towards intermediate goals, while also ensuring that work continues to align with funders' priorities. Unlike milestones, projects seeking renewals must demonstrate the stand-alone value of short-term gains without necessarily having a larger goal as the ultimate objective. Also, renewal does not equate to the funder maintaining a static long-term goal.
Stage 5b. Who does the selection?	
Academic peers: Multiple individuals from academic backgrounds similar to those of the researchers comprise the peer review panel.	*Single person*: The nature of group dynamics may outweigh the benefits of a peer review panel. Leaving the funding decision to an executive or expert programme director centralises responsibility, streamlines the process and may support outside-the-box ideas. Single-person review models may be used for ad hoc funding decisions, or to direct funding across a broad programme area. *Interdisciplinary/multi-stakeholder committee*: Evidence suggests that including research end users in the decisionmaking process for funding improves social relevance and policy impact.[3] Decisionmakers, community members and academic reviewers from cross-cutting disciplines can add perspective beyond the pure scientific merit of a proposed research project.

3 Ismail, S., Participatory Health Research: International Observatory on Health Research Systems, Santa Monica, Calif.: RAND Corporation, TR-667-DH, 2009.

Traditional peer review model	Examples of alternative approaches
Stage 5c. How is the selection done?	
Ranking: Panel makes a group decision on which of the proposals presented to fund, and money is allocated as a grant.	*Allocation by score:* Funding is awarded transparently on the basis of the scores given by reviewers rather than via a group decision. This is an open process, but removes the possibility for discretion by the funding panel, or the use of a portfolio approach to the funding, although it does ensure that all viewpoints are taken into account, and enables funders to include wider groups in the decisionmaking process. *Online/iterative:* Online, iterative methods are an original alternative since the review panel does not have to meet face to face to deliberate and to decide which applications to fund. Delphi exercises are a key example of online methods: panels review applications over a number of rounds, rate and rank them and discuss opinions between rounds in a forum. *Random*: Random funding allocation has been suggested and discussed in the literature, and implemented for small grants, but not on a large scale.

EXAMPLES OF THE OPTIONS IN USE

Throughout this pack we provide examples of where funders have used the approaches that we describe – we aim to provide at least two examples for each model process. In many cases, several different variations on a particular approach have been put into practice; in these, the variations are presented in a table, again with a detailed description of the approach and a real world example.

Some of the new examples presented in this edition were suggested by readers of the previous pack; if you know of further useful examples that should be added, please contact us. We are particularly keen to hear about examples of the use of randomisation and crowd sourcing. Although respondents in our survey of readers expressed interest in both approaches we could only find very small-scale examples of the use of randomisation, and no examples of the use of crowd sourcing, in peer review (although the latter is gaining significant traction in other areas).[4]

EVALUATING ALTERNATIVES TO PEER REVIEW

This pack also suggests the impact that the alternative approaches can have in two dimensions: effectiveness and efficiency. These factors have been selected because they are crucial to the success of a research funding process, as well as being areas in which traditional peer review often receives criticism. It is worth noting that our evaluations are based on evidence from existing literature, which

[4] Birukou, A., J. Rushton Wakeling, C. Bartolini, F. Casati, M. Marchese, K. Mirylenka, N. Osman, A. Ragone, C. Sierra and A. Wassef, "Alternatives to Peer Review: Novel Approaches for Research Evaluation", *Frontiers in Computational Neuroscience*, Vol. 5, Art. 56, December 2011, pp. 1–12.

tends to be biased towards showcasing the merits of a particular approach, rather than balancing it against any shortcomings. This is not intended to be a full evaluation of all the options presented, but rather an illustration of some likely benefits and drawbacks of these approaches that research funders can explore. Various aspects of effectiveness and efficiency defined in this pack are outlined below, and the criteria they assess align with widely accepted peer review standards.[5,6]

EFFECTIVENESS

Outcome

How well does the approach allow funders to achieve their desired outcome, in terms of both intellectual rigour and societal relevance? What assurance does it provide that the quality of the product will be high and consistent with funders' goals? What is the impact on the field and on policymaking?

Innovation

Does the option drive innovation, or does it promote risk aversion and conservatism? Does it reward work that is interdisciplinary, translational and/or applied? How timely is the process, and does this help or hinder innovation?

Credibility

How credible is the option to key stakeholders, given issues of fairness and reliability/reproducibility? Is the option for allocating funding likely to favour certain disciplines, organisations or types of experience? How reliable are the ratings and decisions made by those judging the proposal, and how reliable is the overall process in making final decisions?

Accountability

How transparent is the option? Is it clear how final decisions are made? How are funders and reviewers held accountable for funding decisions and project outcomes?

EFFICIENCY

Applicant burden

Is the burden on applicants appropriate for the amount of funding available?

Funder burden

What is the burden for funders and reviewers? How costly and bureaucratic is the administrative process of proposal review under the approach?

5 Global Research Council, "Statement of Principles for Scientific Merit Review". As of 19 March 2013: http://www.globalresearchcouncil.org/statement-principles-scientific-merit-review

6 AMRC, "Principles of Peer Review". As of 19 March 2013: http://www.amrc.org.uk/research-resources_peer-review

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Defining the scope: Milestones

DESCRIPTION

Major scientific breakthroughs that require a long time to achieve, and that naturally build upon an evolving body of smaller discoveries, are not well supported by ambitious, ex-ante requirements for lofty outcomes. The size and scale of these undertakings – curing cancer or HIV, for example – can be too daunting for any single research group or organisation to undertake. A funding mechanism that encourages researchers to initiate smaller projects while working towards a longer-term goal may be a useful strategy to advance scientific knowledge in the most challenging areas. Milestone-based funding strategies are characterised by intermediate products that aim to make progress towards a specific, pre-defined goal, rather than trying to achieve the goal outright. However, they require the funder to have sufficient knowledge about the correct milestones to set, and also flexibility to allow redirection of the overall strategy if needed. In contrast, a long-term research funding strategy that lacks milestones may commit funders to continue to support projects that are unfruitful.

MAIN EXAMPLE

The Juvenile Diabetes Research Foundation International (*USA*) uses a milestone-based approach to make progress towards a cure for diabetes. Given the complexity of the ultimate goal – curing juvenile diabetes – this method is helpful in breaking down the problem and focusing researchers' efforts in priority areas. One goal identified for 2009, for example, was to activate endogenous beta cell regeneration – an area of basic science inquiry, but one that may provide a critical link to a cure. Within that goal, specific targets were identified that served as reachable milestones which could realistically be addressed. Short-term targets included discovering and validating at least one biochemical pathway, and at least one potential drug target.

VARIATIONS

Type	Example	Description
Milestones in advancing basic science knowledge	Human Genome Project (*USA*)	An initial 15-year plan was released in 1990 for mapping the human genome, with specific targets outlined during that timeframe. Human chromosome 22 was the first milestone to be reached, in 1999; the last chromosome was mapped in 2003. The overall timeframe was later shortened, as technological developments emerged that were able to expedite the process.

EFFECTIVENESS

Outcome

Whether the long-term goal will be reached may be unclear; milestones aim to encourage research in areas where reaching the final outcome is not realistic in the near future. There may be uncertainty about how well the predefined milestones will lead to the final discovery. Milestones can be set based on anticipated scientific impact, although they might also be designed to provide social benefit until the long-term outcome is achieved. In the Human Genome Project, sequencing one human chromosome provided some useful information about conditions linked to that chromosome, for example, even before the rest of the genome was sequenced.

Innovation

Intermediate goals are by design more conservative, and thus less innovative, than major breakthroughs. The timeliness of discovery can be expedited by milestone-based approaches that encourage multidisciplinary collaboration.

Credibility

The credibility of research outcomes is not significantly affected by milestones, which serve to lower obstacles for initiating research more than to change decisions about which projects to fund. Funders' decisions about which milestones are appropriate and have the highest priority are subject to criticism by researchers, however, and bias towards a particular field can occur.

Accountability

Creating a mechanism for reporting short- and intermediate-term outcomes increases transparency, since research findings are demonstrated throughout the lengthy road to research outcomes. Funders are held accountable for their decisions through the same process as in non-milestone approaches.

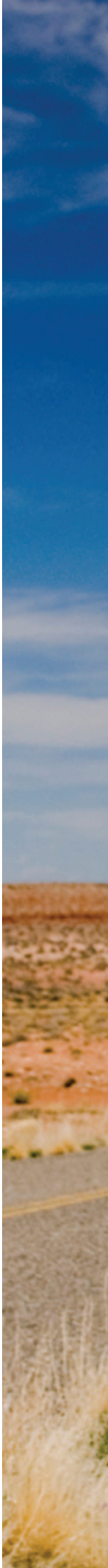
EFFICIENCY

Applicant burden

In comparison to long-term funding with an overarching goal, short-term funding with specific aims is more burdensome to applicants. This is because the applicants must write applications more frequently and provide tangible evidence to demonstrate how they intend to reach the milestone (although these applications might be less complex).

Funder burden

Research funders also face an increased burden when more frequent and specific grant proposals must be reviewed, in comparison to working towards a long-range goal. Milestone-based endeavours may use a similar review process and funding timescale as traditional research projects, so the administrative burden could be the same in that respect. Funders would also need to map the desired pathway to research outcomes; this would require detailed knowledge of the area and would likely increase the funder burden.



RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Defining the scope: Unconstrained excellence

DESCRIPTION

In a standard peer review process, the funding body typically lays out specific research priorities and selects research to fund which supports these aims. However, one commonly used alternative is to select researchers to fund purely on merit, without any criteria regarding the type of research they plan to conduct. This approach is used to award certain research fellowships, for example (see below). Such a broader funding approach offers some advantages as well as disadvantages over a more strategic one: selecting by merit gives freedom to researchers to pursue new and novel ideas and work flexibly, as research questions and opportunities arise, but excellence-based approaches prevent funders from focusing supported research on meeting specific goals or priorities.

MAIN EXAMPLE

Each year, 20 to 30 MacArthur Fellows (*USA*) are selected via peer nomination, whereby about 100 nominators are invited to provide names of the most creative individuals in their field. Applications from individual researchers or unsolicited nominations are not accepted. Recipients are given a stipend of US$500,000 over five years, designed to support people as opposed to projects. Recipients do not have to justify what they do with the award. Nominations are evaluated by an independent selection committee of around 12 individuals from the arts, sciences and humanities professions, and for-profit and non-profit communities. The criteria for selection are exceptional creativity, promise for important future advances based on a track record of significant accomplishment, and potential for the fellowship to facilitate subsequent creative work. Each nomination is evaluated against these criteria on the basis of the nomination letter as well as examples of work by the nominee and wider evaluations or reviews of the nominee's work collected in advance by programme staff. The programme is highly prestigious and rewards excellent research.[7] By selecting based on creativity as well as excellence, the approach aims to capture researchers who are likely to use the money for innovative and novel research. By using a nominations approach, burden on applicants is minimised, and the candidates are to some extent 'pre-selected'. However, because it is based on career assessment, the approach will only reward well-known scientists and not those young researchers without a track record.[8]

7 Venant, E., "MacArthur's Award for Genius Fellowship: The Big Honor Bestowed on Scientists, Humanists and Artists is Prestigious and Comes with No Strings Attached," *Los Angeles Times*, 25th December 1989, p.1.
8 Ioannidis, J.P.A., "More Time for Research: Fund People not Projects," *Nature*, Vol. 477, 2011, pp. 529–531.

VARIATIONS

Type	Example	Description
Broad scope for funding	Danish National Research Foundation (*Denmark*)	The DNRF's Centres of Excellence have no fixed formula; applicants from all fields can be selected to lead outstanding research in fields ranging from medieval literature to biochemistry.
Funding with reduced constraints	Howard Hughes Medical Institute's Investigator Program (*USA*)	This program favours 'people, not projects'. Researchers are employed by the Institute through five-year, renewable appointments, and are free to explore and modify the course of their research over time.

EFFECTIVENESS

Outcome

This approach is not tailored to meet any specific goals or priorities of the research funder, and therefore requires the funder to have a broad approach or outlook. The selection process may remain stringent, which in turn helps maximize the likelihood of positive outcomes for the funding body.

Innovation

This strategy opens up funding to a potentially wider group of applicants and gives researchers the opportunity and freedom to pursue original and innovative approaches. When funding is allocated quickly, it may prove timely support for researchers.

Credibility

Approaches that use merit as an alternative selection approach are likely to be credible to researchers, but suffer from the same challenges with regard to transparency as other peer review processes.

Accountability

Merit is subject to the same issues around transparency and reproducibility as other peer review processes. Where nominations are used to identify candidates, the process may be particularly open to biases and reliant on personal relationships and connections.

EFFICIENCY

Applicant burden

Applicants do not need to prepare specific research proposals and may only need to provide information on their prior career history. There are also likely to be fewer requirements to report on the findings of the research, such as end of grant or progress reports.

Funder burden

For merit review, there is some reduction in burden in terms of identifying and specifying priorities for the selection process.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Generating questions: Sandpit

DESCRIPTION

Research proposals that undergo multiple rounds of review over a lengthy time period may suffer from ineffective interaction between researchers and reviewers, time delays and lingering uncertainty about when and whether projects will be funded. A sandpit model aims to address many of these issues. It brings together researchers, funders and reviewers to interactively discuss and revise proposals at a workshop, prior to making a final decision on which projects will be funded from a predetermined pot of money.

Sandpits provide a forum for brainstorming sessions to foster creativity and generate substantive changes to proposals prior to their final submission. Since funding decisions are made at the end of a workshop, sandpits provide a finite timeframe for proposal review and revision. Appropriate selection of participants is crucial to the success of this approach, as well as effective facilitation/moderation by the funding administrator.

MAIN EXAMPLE

The IDEAS Factory initiative of the Engineering and Physical Sciences Research Council (EPSRC) (*UK*) funded a number of sandpit reviews on topics in need of a fresh approach – such as nutrition for older people, mobile healthcare delivery and coping with extreme weather events. For each topic, a five-day interactive workshop was held, and approximately 20–30 participants attended – including a director appointed to each sandpit from the private sector or academia, and other independent stakeholders. Each sandpit forum offered approximately £1.45 million in research funding for worthwhile project ideas.

VARIATIONS

Type	Example	Description
Cyber-workshops	Takeda-Techno Entrepreneurship Award (*Japan*)	Competing researchers participate in three successive online workshops to discuss each other's proposals, which are shared among participants. A selection committee makes the final decision. One winner is awarded up to 7 million yen (approximately US$56,000) per year, and up to four finalists are awarded up to 500,000 yen (approximately US$4,000) per year. The awards are given for commercial applications of engineering to advance social or individual well-being.

EFFECTIVENESS

Outcome

The opportunity for collaboration and ongoing revision of ideas increases the quality of proposals. Projects that are validated by sandpits undergo greater scrutiny from a broader group of individuals. Sandpit funding may also be reserved for projects meeting a certain threshold for quality, thus providing an even greater assurance of a desirable outcome.

Innovation

The model drives innovation by facilitating interactive discussion with a diverse group of workshop participants. The process can be shorter in duration than peer review, given a fixed timeframe for discussing ideas and awarding funding, although scheduling the sandpits may introduce additional time delays.

Credibility

Bias could be introduced based on the overall composition of the participants (for example, how multidisciplinary the group is), as well as moderator ability to handle dominant individuals and other group dynamics that are also present in traditional peer review. The interactive nature of sandpits could increase quality, but the late stages of review will still suffer the same issues as traditional review panels; in other words, making decisions among a set of high-quality, competing alternatives can be challenging.

Accountability

Increased transparency is achieved among participants, as individual feedback cannot be made anonymously. Responsibility for the funding decision is shared between reviewers and funders, as funders are responsible for facilitating the process and identifying participants.

EFFICIENCY

Applicant burden

More work is needed in advance of the sandpit for applicants to be prepared to respond to critiques, although the fixed timeframe of the workshop limits how long applicants will spend revising proposals. Travel time needed for in-person meetings adds to applicant burden.

Funder burden

Finding an appropriate group of participants with a multidisciplinary perspective imposes an additional burden on administrators, compared with the basic peer review structure which does not require attention to group dynamics. Staff must also be trained to moderate the sandpit, develop agendas, run the meetings and organise logistics for the in-person workshop – which may be a somewhat more labour-intensive process than a single peer review committee meeting. However, sandpits are conducted infrequently (for example, once a year) for special purpose reviews, and all decisions are made within a limited timeframe, so the administrative burden is lower than it would be for strategies requiring continual review and revision.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Refining proposals: Conditional funding

DESCRIPTION

Most peer review processes end once panel reviewers reject an application, even if it receives scores that fall only just short of funding criteria. Alternative options to strengthen promising applications include feedback from the review panel or conditional funding. These collaborative processes can help a funding body achieve its goals by helping high-potential proposals meet their criteria, thus lowering the uncertainty associated with high-risk innovative research and the delays incurred by resubmission. Conditional funding focuses on 'hands on' guidance to ensure the proposal meets specific criteria before the funding is issued. Through conditional funding, officers from the funding body mentor applicants to improve applications that have passed a quality threshold but fall short of funding criteria, before providing funding.

MAIN EXAMPLE

The Canadian Foundation for Healthcare Improvement (CFHI), formerly the Canadian Health Services Research Foundation (CHSRF), chiefly funds research about the health system. CFHI features a multidisciplinary Peer Review Panel composed of policymakers, clinicians and expert scientists, bringing decisionmakers and researchers together to maximise the impact and relevance of the research it funds according to two core criteria: scientific merit and potential impact. In cases where the CFHI merit review panel members feel that the scientific merit of an application with high potential impact can be improved, panel members may recommend to CFHI's board of trustees that the application be funded via a 'risk-venture' approach. This involves panel members (usually a researcher and a decisionmaker) being assigned to the application to help the applicants improve 'fatal methodological flaws' before the project begins. Projects mentored in this way are required to report internally in more detail, to ensure the project is on track.

VARIATIONS

Type	Example	Description
Recommendations to improve the application	National Health and Medical Research Council's (NHMRC) Partnership Centres (*Australia*)	The International Expert Review Panel can award funding conditional on specified revisions to Partnership Centres' proposals. Alternatively, the Panel may recommend revision of an application in accordance with specific feedback before resubmission later on.[9]

[9] NHMRC, "NHMRC Partnerships for Better Health: Partnership Centres Peer Review Guidelines – 2012–13", 2012. As of 19 March 2013: https://www.nhmrc.gov.au/_files_nhmrc/file/grants/apply/strategic/partnership_centre_peer_review_guidelines_121011.pdf

Type	Example	Description
Collaborative feedback to improve the application	Healthcare Research Grants at the Motor Neurone Disease Association (*UK*)	The UK's Motor Neurone Disease Association can depart from its traditional peer review processes when allocating Healthcare Research Grants. Following the submission of one or more potential applications, the Research Advisory Panel works with the researchers to improve specific points through feedback and discussion before the application or applications are sent for external peer review.

EFFECTIVENESS

Outcome
Providing feedback and funding conditionally enables the funding body to ensure the proposal is tailored to their overarching goals, meets high scientific standards of quality, and ultimately may produce better outcomes.

Innovation
By identifying and correcting flaws in applications, conditional funding may enable wider teams or research products to be funded, as well as ideas that have high relevance for the funder but that require methodological improvements to be supported and funded.

Credibility
The credibility of this process is strengthened by the transparency resulting from feedback and the support to applicants, and by utilising a panel of stakeholders representing multiple areas of the field.

Accountability
Transparency is achieved by providing feedback and comments from the panel discussion to applicants as part of the assessment process.

EFFICIENCY

Applicant burden
The process enables applicants to save time by adjusting proposals after submission. On the other hand, the dialogue element means additional demands are made on the applicants to improve their application to meet conditions.

Funder burden
Reviewers need to expend effort on each proposal to prepare tailored feedback and to 'mentor' specific proposals that are conditionally funded yet need strengthening. Funding bodies need to coordinate feedback as well as handle applications.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Refining proposals: Mentored

DESCRIPTION

To minimise the risks associated with certain types of research, or to ensure research proposals closely match its goals, a funding body can choose to mentor applications. In its basic form, the process consists of providing assistance to all applicants as they develop their applications. The funding body may systematically provide guidance and support to applicants before proposals go through the peer review process, or it may choose to help strengthen only those applications that pass a certain quality threshold (see the card on conditional funding for more details).

Mentoring applications from start to finish may help the funding body strengthen the pool of applications to select from and ensure they are aligned with its broader objectives. On the other hand, the method may 'water down' riskier research proposals and reduce the apparent independence of the funding body in making the decision to fund the research. Also, the responsibility for success or failure can be blurred between the researcher and the funding body.

MAIN EXAMPLE

The Venture Research Unit was in operation at British Petroleum between 1980 and 1990, during which time it provided £15 million of research funding. The core mission of the initiative was to fund only unconventional work that was not possible under conventional peer-reviewed funding strategies by maintaining a 100% high-risk balance portfolio. The funding strategy was designed to maximise flexibility, in order to allow full intellectual freedom for creativity. The unit was supported by a secretariat that played a crucial role in reaching out, selecting and recruiting applicants (notably through travelling and giving talks in European and North American universities). The secretariat worked collaboratively with applicants to help them write and strengthen proposals so that they would be successful with the Venture Research Advisory Committee, which had oversight of the unit.[10]

VARIATIONS

Type	Example	Description
Mentoring and support for researchers	Ontario Brain Institute (*Canada*)	The Ontario Brain Institute features a system to mentor and support researchers (currently being reviewed and updated).

[10] Braben, D.W., *Scientific Freedom: The Elixir of Civilization*, Hoboken, N.J.: John Wiley & Sons, Inc., 2008.

EFFECTIVENESS

Outcome

This mechanism allows the funding body to strengthen weak areas of the proposal and therefore to maximise chances of an outcome that is aligned with its goals. Although it has been claimed that the process fosters innovative research, no direct comparison of outputs and outcomes has been undertaken.

Innovation

Mentoring applications potentially allows funding bodies to experiment with higher-risk, more innovative research, while giving funders control to mitigate some of the risk. On the other hand, the funding body may substantially modify proposals for higher-risk research to minimise risk.

Credibility

It is necessary for the funder to have a solid reputation in the field. The expertise and credibility of the individuals providing the mentorship is also critical to the success of the approach.

Accountability

The underlying risk is that the independence of the applicant from the funder is reduced when the funder is involved in improving the application: overall this could be seen to compromise accountability on both sides.

EFFICIENCY

Applicant burden

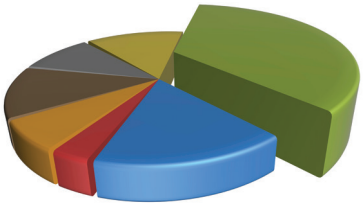
Burden on the applicant may be slightly higher due to interactions with officers or the secretariat from the funding body. However, it is expected that the research funder would cover the extra time.

Funder burden

More effort is required on the part of the funding body, since it needs to provide the mentoring support to the application. However, it can be argued that the extra effort may be counterbalanced by a higher-quality end product.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.



What is the selection based on? Portfolio

DESCRIPTION

Funding organisations aim to maximise the impact of the body of research they support, often in accordance with an established set of priorities. A portfolio approach balances resources across projects with varying levels of risk, uncertainty and potential impact. Low-risk projects are often short-term, conservative and build upon an established body of knowledge. Major breakthroughs may require investment in high-risk projects, where there is less certainty about the likelihood of success. Funders may use a portfolio approach to support a range of high-, medium- and low-risk projects in a bid to foster high-risk but potentially high-impact research. The research community in general is often criticised for being overly conservative, favouring low-risk, low-return projects. However, examples of higher-risk portfolios have been seen in some smaller, private foundations.

MAIN EXAMPLE

In the United States, the Robert Wood Johnson Foundation (RWJF) evaluates its funding allocation across various dimensions for impact and risk, such as: solicited/unsolicited proposals; repeat/new grantees; grant size; renewed/new programmes; type of grantee organisation; and research topic. The vast majority of spending is allocated to predetermined research priorities, which may generally be perceived as lower-risk and more predictable in their outcome. In 2007, high-risk awards comprised around 8 percent of spending. RWJF conducts annual evaluations and adjusts its spending allocation accordingly, with the goal of maximising impact across a diverse project portfolio.

VARIATIONS

Type	Example	Description
High-risk balance	The Wellcome Trust's Showcase awards (*UK*)	Showcase awards were designed to fund high-risk research that was unlikely to be selected via the traditional peer review process. Between 1996 and the early 2000s, about 20 such awards (for about £40,000 over 12 months) were given each year.[11]
Low-risk balance	National Institutes of Health (NIH) Director's Awards (*USA*)	NIH operates almost entirely on a peer-reviewed proposal basis. Less than one percent of its funds are allocated to its Director's Award programme, which is designed to support high-innovation, high-risk projects.

[11] Grant, J., and L. Allen, "Evaluating High Risk Research: an Assessment of the Wellcome Trust's Sir Henry Wellcome Commemorative Awards for Innovative Research," *Research Evaluation*, Vol. 8, No. 3, 1999, pp. 201–204.

EFFECTIVENESS

Outcome

Funders with high-risk portfolios must be able to accept that breakthrough discoveries take time, and some projects may be unsuccessful. However, low-risk portfolios tend to focus on short-term outcomes and have only a modest impact. Programme evaluations of overall impact and expected return can help funders understand how to optimise outcomes within the realities of their organisational structures.

Innovation

A diverse portfolio of funding strategies is more likely to produce significant original research than a single focused one. Critics of conservative project selection note that innovation is hindered by low-risk strategies, arguing that more support of higher-risk projects is needed. By their design, low-risk projects typically have well-defined trajectories, and can provide greater assurance of success by citing existing work. Ground-breaking, out-of-the-box, controversial research is, in contrast, high-risk; outcomes are uncertain and cannot be substantiated beforehand.

Credibility

Funders with higher-risk portfolios may face criticism in the short-term if milestones and results are not demonstrated. The Defense Advanced Research Projects Agency (*USA*) allows individual programme managers the flexibility to make high-risk funding decisions, but also holds them accountable – projects may be terminated before completion. However, the credibility of individual project funding decisions should not be influenced by the overall portfolio balance.

Accountability

Proposal criteria for low-risk projects are generally well known and transparent. In comparison, what is considered 'innovative' for a high-risk project is more subjective, and it may be unclear how risk and expected return are measured.

EFFICIENCY

Applicant burden

For individual applicants, burden should not be affected by the overall allocation of risk across a funding portfolio, though it may be important for them to be aware that this approach is being used in order to correctly target their applications.

Funder burden

Determining what balance of risk is optimal for an organisation is an ongoing and time-consuming task. Initial efforts to diversify and manage a funder's portfolio will also increase administrative burden, if new processes must be initiated or existing ones expanded in order to accommodate changes in programmatic areas.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

What is the selection based on? Ad hoc / discretionary

DESCRIPTION

While pre-established programme goals are the norm in awarding research funding, reserving a portion of funds for ad hoc, discretionary projects gives organisations additional flexibility to respond rapidly to emerging needs. This option is characterised by a streamlined or expedited decisionmaking structure for topics that fall outside pre-identified boundaries, and by greater sensitivity to urgent research needs. Rapid-response grants for small amounts of funding or for specific issues are used by several bodies, including the Natural Hazards Center (*USA*), the Natural Environment Research Council (*UK*), and the William J. & Dorothy K. O'Neill Foundation (*USA*).

MAIN EXAMPLE

The William and Flora Hewlett Foundation (*USA*) awards a substantial proportion of its funds to special projects. These allow the foundation's president to serve as the programme officer, making discretionary funding decisions for unexpected reasons, or in exploratory areas not covered in the existing programmatic structure. Special project topics are more unusual, and include nuclear non-proliferation and the measurement of well-being. In 2007, US$159,069,100 in Special Projects grants were awarded – 33 percent of the foundation's total grants that year.

VARIATIONS

Type	Example	Description
Quick response grant	Michael J. Fox Foundation Rapid Response Innovation Awards (RRIA) program (*USA*)	The RRIA is designed to support high-reward, high-risk projects that have little preliminary data but may significantly impact treatment of Parkinson's disease. There is no fixed submission deadline for these US$75,000 grants, and funding decisions are made within 6 weeks.
Small grants/ exploratory work	National Science Foundation (NSF) Small Grants for Exploratory Research (SGER) (*USA*)	On a rolling basis, NSF Program Officers may grant awards of up to US$200,000 for two years for high-risk, exploratory research outside the standard research portfolio. The programme funds untested ideas, transformative research, new approaches and urgent issues such as domestic responses to major natural disasters.

EFFECTIVENESS

Outcome

Relatively greater emphasis is placed on the size and scale of the outcome, compared to the likelihood of success. Major scientific breakthroughs, smaller-scale but novel ideas and timely responses to high-visibility public issues are well-suited for discretionary funding.

Innovation

The flexibility and responsiveness of discretionary funding is specifically designed to support innovative projects unlikely to be funded through the traditional peer review process. Decisionmakers can respond rapidly to the creative potential or societal impact of proposed projects, rather than deciding in advance how to set research agendas. Decisions are thus expedited, and the review process is timely.

Credibility

Discretionary funding awards are often viewed with greater scepticism, particularly when the decision process is streamlined and opaque, perhaps with only a single reviewer. Reliability and reproducibility are low, and equity may be compromised, given the lack of a consistent decisionmaking process.

Accountability

Public agencies that face greater public scrutiny typically reserve a relatively small portion of their funds for discretionary research, since this option decreases accountability. Larger shares of discretionary spending are possible in private foundations, which have less public pressure.

EFFICIENCY

Applicant burden

Applicants may resort to discretionary grants after failing to obtain funding through the usual channels, which increases total burden and decreases timeliness. The usual requirement to demonstrate expected outcomes is relaxed, so applicants focus instead on making the case for the transformative potential of projects. If the grant is small, as is common with discretionary funding, researchers may face a higher burden of seeking additional funding to continue their work.

Funder burden

The level of administrative burden can often be lower than for established programmes, as decisionmakers have greater autonomy to act when the appropriate opportunity arises, rather than needing to map out a plan in advance. In addition, funders must screen potential projects to determine whether they meet general eligibility guidelines, and from there may undertake additional efforts to evaluate the merits of proposed projects.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

What is the selection based on? Ex-post awards / prizes

DESCRIPTION

The careful review of research proposals is designed to help identify the most promising projects and those that are most likely to achieve the desired outcome. There is uncertainty about whether researchers will be successful in reaching the pre-specified end point, however, particularly in the development of new technologies. Ex-post awards, or prizes, can inspire creative approaches to a technological need by awarding money to high-impact scientific work *after* the work has been completed, based on whether competitors have achieved desired outcomes. Financial risk to the funders is largely eliminated with this system and passed on to those competing for the award instead.

MAIN EXAMPLE

The Defense Advanced Research Projects Agency (DARPA) (*USA*) Grand Challenge was a military agency-funded effort to field-test autonomous, unmanned, robotic ground vehicles that could be used in the battlefield. The first challenge, held in 2004, offered a US$1 million award to the fastest vehicle to successfully complete a 300-mile on/off-road desert course in the allotted time – but there were no finishers. The next year, the award was increased to US$2 million. Five autonomous vehicles completed the course, a winner was announced, and the competition was thus discontinued.

VARIATIONS

Type	Example	Description
Ongoing prize awards	Methuselah Foundation M-Prize for longevity (*USA*)	To further knowledge about how to extend human longevity, the M-Prize award is given when the world record lifespan for a mouse is broken. The prize structure pays a fraction of the total award endowment when the record is broken, and increases as longevity continues to be extended. There is, therefore, an ongoing incentive to keep extending longevity, rather than stopping once a set goal is reached.
Patent-type prizes	Medical Innovation Prize Act of 2007 (*USA*)	This legislation, proposed in the US Congress, aimed to eliminate the pharmaceutical patent system, instead establishing a fund equal to 0.6 percent of GDP (US$80 billion in 2007) to be awarded for pharmaceuticals that improve health outcomes.

EFFECTIVENESS

Outcome

Ex-post awards are valuable to funders since they guarantee the desired outcome and pass financial risk on to researchers/inventors. Setting the right level of difficulty is important, however, since challenges that are too hard may become a barrier to entry. Prizes for sequential discoveries may help address this as well as speeding discovery by advancing knowledge incrementally. Although some prizes are better suited to advancing science and technology outcomes, those with a market value (for example, patent-based 'prizes') provide direct social benefit. If the object of the prize does not have market value, however, additional incentives will be needed to encourage contest participants to develop the technologies for public use.

Innovation

The route to discovery is not predefined as in an ex-ante research effort, so any number of creative methods to reach the goal may be used. Innovative outcomes are thus procured by the basic design of the prize system. Given the infrequency with which major prize competitions are held, the timeliness of discovery may be set back one year or more if success is not achieved initially. The competitive nature of prizes also results in duplication of effort, which hinders the speed of innovation compared to collaborative approaches.

Credibility

Some prize awards have clear-cut winners, but others do not. The judging process must be well defined, minimise subjectivity and allow for appeals in order to ensure the credibility of the prize decision – otherwise there is a risk of favouritism and industrial influence. Equality of opportunity may not be achieved for participants with insufficient cash flow to initiate projects without ex-ante funding.

Accountability

Contest rules are known by all participants. To the extent that the 'best' outcome is well defined, and judging panels primarily serve to ensure that the rules have been met, transparency is high.

EFFICIENCY

Applicant burden

The bulk of the burden and financial risk must be borne by contest participants, who may or may not see any reward for their investment under this system.

Funder burden

Although funders do not provide input or direct assistance in achieving the outcome, work is needed to manage contest participants throughout the process. A prize system requires funders to develop contest rules, determine the appropriate size of the prize, pre-screen eligible applicants, and organise and run the contest. Funders may still opt to select candidates for the competition initially, meaning more preliminary work is required.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

What is the selection based on? Renewal

DESCRIPTION

The duration of funding can be an important determinant of the scale and impact of a project. Large investments in long-term projects can be difficult to justify to funders without high certainty about the likelihood of success. Creating the option to renew funding for a project based on ongoing progress, lowers the risk for funders while giving researchers a more feasible channel to pursue long-term projects. The initial award of project funding may require the usual peer review stamp of approval. Funding renewals differ subtly from milestones in that the former allow more flexibility in the definition of intermediate outcomes. Renewals are not necessarily aimed at achieving a single, breakthrough discovery, and can be used more broadly to determine whether various projects merit additional funding.

MAIN EXAMPLE

The National Institutes of Health (NIH) (*USA*) offers project renewal opportunities – called type 2 grants – that have a higher chance of being funded compared to new applications. In 2005, 32 percent of type 2 applications were funded, compared to 9 percent of type 1 (new proposal) submissions. Type 2 applications also require competitive peer review for approval, and are judged on progress made to date. If the scope or direction of the project changes significantly, then a new proposal must be submitted instead of a renewal.

VARIATIONS

Type	Example	Description
Long-term programme grants	British Heart Foundation (*UK*)	Long-term programme support is provided on a five-year rolling basis. Renewal applications are reviewed by an external peer review panel and internal programme grants committee; revision of the research proposal is typically required. The renewal process begins 18 months before the end date of the current award. This strategy lowers the barrier to renewal of existing projects and supports long-term programmes that can demonstrate success within five-year intervals.

EFFECTIVENESS

Outcome

Compared with milestones, renewals are more open ended and allow greater flexibility in demonstrating success without ex-ante constraints. A funder's programme priorities may change over time, which reduces the degree to which this feature supports long-term work. Failure to obtain renewal funding can break apart research teams, disrupting potential breakthroughs that require longevity in funding. For funders that award renewals at a high rate, this is less of an issue.

Innovation

The proportion of a funder's resources that are allocated to new versus renewal applications might be viewed as an indicator of innovation; increased funding for renewals implies less funding for creative new approaches. Renewal funding is particularly helpful for innovative breakthroughs that take a long time to realise; however, it is unclear what balance of new versus renewal funding is optimal to drive innovation. Projects requiring longer timelines to demonstrate intermediate success may also have difficulty obtaining renewal funding, as results may not be demonstrable at the renewal point.

Credibility

Review of renewal applications is based on outcomes and objective criteria, but bias may stem from programme staff recommendations and organisational issues at the time of renewal. Bias may actually be increased with renewals compared to large new project awards since the latter may place a greater emphasis on transparency and fairness.

Accountability

Renewal applications and programme evaluations are used to evaluate the effectiveness of projects and to determine whether they are worth continuing. This promotes increased accountability due to the ongoing scrutiny applied to project outcomes.

EFFICIENCY

Applicant burden

The duration of funding before renewal is a key factor with respect to applicant burden. Applying for grant renewals through reapplication and/or ongoing programme evaluation, in addition to the initial grant proposal process, adds to the burden for applicants. The perceived likelihood of receiving renewal funding, as well as initial project start-up costs/burden, will also affect researchers' willingness to seek this type of funding.

Funder burden

Reviewing renewal applications requires staff time, but the level of burden may be reduced due to familiarity with established projects, in comparison with the review needed for new project ideas. The project has already been deemed worthwhile, so if peer review was used for reviewing the initial project award, then reducing the role of peer review in the renewal process can be justified.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Who does the selection? Single person

DESCRIPTION

With a complex review process that incorporates multiple decisionmakers and metrics, bureaucracy and peer review panel group dynamics may have a negative impact on decisionmaking. Requirements for broad-based group consensus in a peer review panel also promote conservatism, since controversial ideas are not likely to be accepted by a large number of individuals. Single-person review models streamline the process by granting full responsibility for reviewing project merits to one person, although it also places a great deal of responsibility and power in his/her hands. Ad hoc funding strategies generally employ a single, executive decisionmaker; however, a single person can also be tasked with portfolio management for a predefined programme area.

MAIN EXAMPLE

The Defense Advanced Research Projects Agency (DARPA) (*USA*) hires highly qualified, entrepreneurial Programme Officers for four to six years to assume responsibility for managing and granting research funding in their field of expertise. The non-renewable, short term of service is designed to encourage risk taking and foster innovation in project funding. Programme Officers use external peer review committees for advisory purposes, but they have full autonomy to make the final funding decision.

VARIATIONS

Type	Example	Description
Executive reviewer	University College London Provost's Venture Prize (*UK*)	This prize funds an individual for innovative research in 'paradigm-shifting ideas' that challenge the status quo. The selection process focuses heavily on the innovative promise of research – it eliminates deadlines, milestones, peer review and most other rules. The University Provost and President make the final funding decision, weighing recommendations from a selection team.
Single 'champion'	Grand Challenges Explorations Grants (*United States*)	After applications are reviewed by internal staff, they are sent to leading experts. No consensus between experts is needed: all that is required for the grant to be awarded is that one of the reviewers champions an application.

EFFECTIVENESS

Outcome

Single-decisionmaker models can encourage risk taking, as group decisions tend to be more conservative, and funders can use this option to show their willingness to fund projects where the outcome is highly uncertain. However, this will depend to a large extent on the conservatism of the decisionmaker, who may also be reluctant to take sole responsibility for the allocation of funds to high-risk areas.

Innovation

The central focus of many single-decisionmaker models is innovation. Peer review panel decisions tend towards conservatism, and eliminating the need for group consensus opens up the possibility of deviation from the average.

Credibility

Individuals with full responsibility for a decision potentially face more criticism about credibility, and thus may take additional steps to demonstrate their competence. This option must ensure that the single decision has strong credibility, coming from an expert in the field. Reliability in terms of quality of decisionmaking compared to committee review is unclear; however, there is evidence that committee decisions – particularly at the margins – are not reproducible.[12] Committees may appear more credible in their design, but they often defer to minority opinions and/or dominant members. This reduces the democracy of the design and adds little value compared to a single decisionmaker.

Accountability

Increased accountability is guaranteed when the decision is limited to one individual. However, the transparency of the decisionmaking process is likely to be reduced, in that an individual's reasons for making decisions may not be as explicitly documented as in a committee process.

EFFICIENCY

Applicant burden

The application process is streamlined by the centralisation of decisionmaking power. In situations where researchers can modify their applications, they avoid having to respond to conflicting criticisms.

Funder burden

The level of administrative burden depends on the selection process, rather than the fact that a single person is the final arbiter of decisions. If external peer reviewers provide guidance to the single decisionmaker, then administrative burden is not significantly reduced. The extent to which internal staff must conduct pre-screening and advise the single decisionmaker is therefore important. Although the final decision is made by one individual, many more may be involved in the process.

12 Graves, N., A.G. Barnett and P. Clarke, "Funding Grant Proposals for Scientific Research: Retrospective Analysis of Scores by Members of Grant Review Panel," *BMJ*, Vol. 343, 2011, pp. 1–8.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

Who does the selection? Interdisciplinary / multi-stakeholder committee

DESCRIPTION

Traditional peer review panels tend to be comprised of researchers in the primary field of study. Diversifying the composition of review panels encourages interdisciplinary and user-focused research, which may expand both scientific and social relevance. Committees may also be augmented by non-researchers who are stakeholders in the process or outcome, and who can better evaluate the social and practical utility of the work. However, interactions between panel members must be moderated effectively for this to work well. A potential shortcoming is that single-discipline reviewers may be overly critical of methodological issues with which they are unfamiliar, and be biased towards research that aligns better with their own field.[13, 14]

MAIN EXAMPLE

The Canadian Health Services Research Foundation (CHSRF) uses Merit Review Panels for evaluating all proposed funding, which include individuals from research and decisionmaking communities. Its Nursing Care Partnership (NCP), for example, which is run through the Canadian Nurses Foundation, administers funding to partner organisations. Partners must employ a dual review process – one with scientists who have expertise in bioethics, statistics and research methodology, and another with decisionmakers in health care management and delivery. The NCP executive panel oversees the partner organisations' funding decisions, and ensures that the partners' review panels meet the interdisciplinary/multi-stakeholder criteria. The executive panel also includes three or more reviewers with at least one healthcare decisionmaker. Research proposals place a heavy emphasis on describing the potential impact on patient care.

VARIATIONS

Type	Example	Description
Community or professional end users review proposals	Canadian Institutes of Health Research community reviewers	Non-researchers are invited to apply to be community reviewers. These individuals may be healthcare service providers, business leaders, policymakers, programme administrators, educators, journalists and interested members of the general community. They provide feedback on the lay abstract, focusing on importance and clarity, but do not vote or score proposals.

13 Laudel, G., "Conclave in the Tower of Babel: How Peers Review Interdisciplinary Research Proposals", *Research Evaluation*, Vol. 15, No. 1, 2006b, pp. 57–68.

14 Langfeldt, L., "Expert Panels Evaluating Research: Decision-making and Sources of Bias", *Research Evaluation*, Vol. 13, No. 1, 2004, pp. 51–62.

Type	Example	Description
Researchers from multiple academic disciplines review proposals	National Science Foundation reviewer selection process (*USA*)	All proposals are reviewed by an NSF Programme Officer and usually three to ten external peer reviewers. The NSF specifically supports interdisciplinary research, and the reviewers for those proposals must be appropriately selected to understand broader impact as well as scientific merit.

EFFECTIVENESS

Outcome

If a funder's priority is to increase social relevance and impact, then interdisciplinary/multi-stakeholder review panels are a useful option. Incorporating a broader range of perspectives into the review process ensures that the research findings are of interest to a more diverse group of stakeholders.

Innovation

Review panels are more likely to recognise innovative thinking when a variety of perspectives is involved. If the panels do not effectively interact, however, then minority or dissenting opinions may not be heard, for example if decisionmakers who lack technical expertise are not taken seriously. The selection process, in addition to determining the composition of the review panel, must actively support interdisciplinary thinking.

Credibility

Increased stakeholder engagement and buy-in to the research product is achieved, and favouritism towards a particular field of study is less likely. Strategies must be in place to ensure that scientific rigor is not compromised, and to preserve continued credibility among researchers.

Accountability

There is greater transparency with regard to end users, given their involvement in the process of reviewing proposed research.

EFFICIENCY

Applicant burden

More work is required by applicants to demonstrate and clarify whether the interdisciplinary approach is reasonable, and to ensure that the proposal's merits are appreciated by a broad audience while retaining a sufficient level of technical detail to satisfy the scientific reviewers.

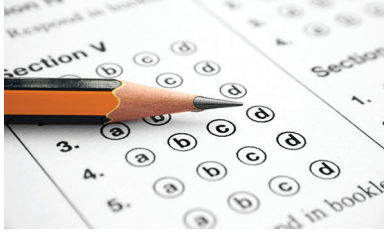
Funder burden

Additional effort is needed to select appropriate reviewers to meet the interdisciplinary and participatory needs, and to ensure that panels are run effectively; this method is not as straightforward as the traditional peer review panel selection process in that it is time and resource intensive.[15]

[15] National Institutes of Health (NIH), "2007–2008 Peer Review Self-Study: Final Draft", 2008. As of 19 March 2013: http://enhancing-peer-review.nih.gov/meetings/NIHPeerReviewReportFINALDRAFT.pdf

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.



How is the selection done? Allocation by score

DESCRIPTION

Typically, funding is allocated by group decisionmaking of the peer review panel after discussions. This allows a consensus to be reached, but runs the risk that certain opinions may dominate the decisionmaking process, and requires effective facilitation to ensure all voices are heard, particularly if lay research users are present. One way to avoid this is to allocate funding by score: all reviewers score proposals, and the decision is taken on the basis of these scores, which are also provided to the applicant. This guarantees transparency, since the applicants can see their score relative either to a cut-off for funding, or relative to other applications, but it does remove some of the discretion of the panel.

MAIN EXAMPLE

Asthma UK uses a scoring system for the allocation of research funding. This was initially adopted to ensure transparency and objectivity, but has also helped to ensure effective inclusion of the views of lay reviewers who have been included in the review panel since 2008. The approach is based on a six-point scoring system that ranks applications on a scale from 1 ('not recommended') to 6 ('top priority for funding'), and consists of three stages. First, four panel members, including one lay panel member, are asked to assess the proposals and score them. The average scores are used to eliminate around a third of the total number of proposals (typically, around 60 to 65 in total each year).

The second stage consists of a wider review, with each proposal sent to three further lay reviewers and three external, international expert reviewers. The ten scores per proposal are used to calculate an average score for each proposal, weighting the expert scores at a ratio of 3:1 relative to the scores of lay reviewers (a ratio established through pilot initiatives by Asthma UK). Further discussions are then held, and applicants are sent the comments (though not the scores) and are given the opportunity to modify their proposals.

The third stage is a peer review panel session including the original four panel members for each application. The panel is made up of approximately 25 people including scientific experts and lay members. All the proposals are discussed, with a focus on those which are middle ranked and where the decision on whether or not to fund appears less clear. After further reviews, a final score is given, and funding is allocated from the top of the list. Applicants are provided with any further feedback from the panel meeting along with the outcome of their application. The whole process takes around 6 months from the application submission deadline to outcome.

VARIATIONS

Type	Example	Description
Scoring on specific criteria	National Institutes of Health (NIH) (*USA*)	For research grants and cooperative agreements, reviewers provide a score on a 1–9 scale for (at least) five review criteria: significance, investigator(s), innovation, approach, and environment, as well as an overall impact score. Scoring takes place after panel discussions and is private; scores are provided to applicants.
Calibrating panel scoring	Canadian Institutes of Health Research (CIHR) (*Canada*)	The CIHR's best practice guidelines for peer review committees state that a calibration exercise should be undertaken at the beginning of each panel meeting by evaluating 'one top, mid and bottom ranked application' in order to set the scoring range for the meeting.[16]

EFFECTIVENESS

Outcome

Incorporating the views of wider stakeholder groups increases the likelihood of research being conducted that is tailored to societal needs. The approach also prevents the domination of the decision-making procedure by a few individuals.

Innovation

While group decisionmaking is considered more risk averse, combining this with individual scoring may enhance possibilities for innovation. However, averaging scores across different reviewers may reduce the likelihood of riskier innovative research being funded.

Credibility

Likely to be credible to stakeholders as it provides a fair and inclusive way of combining judgements across the reviewing group.

Accountability

Increased transparency is one of the key advantages of this approach. By clearly recording each decisionmaker's view during the process, and, where applicable, by giving applicants their scores, the latter can clearly understand how applications are selected for funding and those making those decisions are directly held to account.

EFFICIENCY

Applicant burden

The process should not make any significant difference to the burden on applicants.

Funder burden

In addition to participating in a panel, reviewers will be asked to score proposals. However, this may speed up the review panel session since no final consensus needs to be reached, just all views aired and discussed. There is some additional burden to the funder in combining the scores to reach a funding decision.

16 CIHR, "CIHR Instructions for Chairs", 2011. As of 19 March 2013: http://www.cihr-irsc.gc.ca/e/40211.html

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

How is the selection done? Online/iterative

DESCRIPTION

Organising panel meetings may place a substantial financial and time burden on the funder. To avoid such issues and to focus the review on consensual decisionmaking, alternative designs include online methods for deliberation. One example is an online Delphi process: a technique used for collecting large quantities of qualitative or quantitative information – principally expert or stakeholder opinion – in a structured fashion from a large number of geographically and temporally distributed individuals with different areas and levels of expertise.[17] Delphi peer reviews enable experts to score, discuss and re-score grant applications over two or three rounds. The funder can also choose to have its review panel deliberate online instead of face to face.

MAIN EXAMPLE

In 2009, Cancer Council New South Wales (CCNSW) in Australia announced a funding round for Innovator Grants of AU$100,000 for one year to fund 'high risk–high return' research on pancreatic cancer. Given a higher number of applications than planned and the potential risk of conflicts of interest since researchers bidding for the grant were also potential reviewers, CCNSW opted for an online, iterative approach to making funding decisions. It set up an independent scientific panel of five members (mostly researchers based in the United States) to review grant applications – which were six pages long, to limit the administrative burden – online via a Delphi process designed to foster consensus. The review lasted for three rounds over two weeks: after each round, the two lowest scoring applications were rejected. During the first round, applications were assessed and ranked according to their scientific merit and quality; the second round ranked applications according to their innovative potential; while in the third and final round, participants were asked to weigh potential risks and returns for each application and to rank them accordingly. The panel never met face to face, and reviewers seemed to accept the use of this method.[18]

VARIATIONS

Type	Example	Description
Online peer review	Canadian Institutes of Health Research (CIHR) (*Canada*)	When it performs 'structured reviews' to award certain types of grants, CIHR uses its ResearchNet platform, which enables researchers to meet virtually to discuss applications online, notably via video conference.

[17] Ismail, S., "Delphi Exercises", 2009, in Ling, T., and L. Villalba van Dijk, *Performance Audit Handbook: Routes to effective evaluation*, Santa Monica, Calif.: RAND Corporation, TR-788-RE.

[18] Holliday, C., and M. Robotin, "The Delphi Process: a Solution for Reviewing Novel Grant Applications," *International Journal of General Medicine*, Vol. 2010, No. 3, 2010, pp. 225–230. As of 19 March 2013: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2934605/pdf/ijgm-3-225.pdf

EFFECTIVENESS

Outcome

The consensus-based approach to peer review favoured by the Delphi technique may foster better outcomes in terms of quality and for the funding body, since panel experts agree on the winning proposals. Online participation allows funding bodies to include experts who wouldn't otherwise be included, which can help deliver a better outcome. On the other hand, some reviewers have argued that the virtual environment hinders interaction and deliberation between panel members.

Innovation

In general, online methods have no direct effect on innovation as such, but the tendency for online processes to be more structured allows innovation to be made more explicit as a criterion. For instance, the CCNSW used an 'innovativeness score' in the second round of its Delphi process.

Credibility

Through the online process, conflicts of interest that may arise when review panels are composed of local experts may be avoided, since leading reviewers from around the world can be brought together to assess and score applications.

Accountability

The method is reproducible, and accountability can be achieved through the high degree of transparency resulting from online deliberation, since records of the debate can be systematically kept.

EFFICIENCY

Applicant burden

The necessity for experts to review applications over several rounds (in online Delphi exercises) creates an incentive for funding bodies to issue calls for shorter applications, which can reduce the burden for applicants.

Funder burden

Reviewers save time by not having to travel to a central location to meet, and the funder can collect feedback through a centralised system. Online reviews within a set timeframe enable reviewers to fit the process within their schedules. In some cases, however, the time lag between rounds means that reviewers have to reacquaint themselves with the application before each round.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

How is the selection done? Random

DESCRIPTION

The idea of randomly allocating research funding has been developed theoretically and is used by some institutions for small grants. Although it is mentioned in think pieces and articles, it has not, to our knowledge, been applied to large-scale research funding allocation.[19] Within this process, much variation exists: on the one hand, funding could be allocated completely randomly, while on the other, random allocation could be applied to proposals that pass a certain quality threshold. The main benefits deriving from this approach are that funding may be allocated regardless of the reputation or qualification level of the applicant, although it does not guarantee that the most deserving or scientifically solid proposal is funded. The use of random funding could be restricted to proposals that fall between those which are guaranteed funding and those which do not meet quality or scientific criteria.

MAIN EXAMPLE

The Foundational Questions Institute (FQXi) in New York uses a lottery system to randomly award funding in the broad area of cosmology and physics. It awards mini-grants, which range in value from US$1,000 to US$15,000, for travel, lecture programmes, workshops and other small projects initiated by FQXi Members. This approach has a small administrative burden, is completely transparent and avoid any biases that could be present in the peer review process (e.g., against specific fields or early career scientists).

VARIATIONS

Type	Example	Description
Random allocation for applications above a certain threshold	'Focal randomisation' mechanism	This theoretical model recommends funding projects that are ranked by reviewers as being the best, rejecting projects which have less value, and using random allocation for those in between, the value of which cannot be easily assessed by reviewers.[20, 21]

[19] Ioannidis, J.P.A., "More Time for Research: Fund People not Projects," *Nature*, Vol. 477, 2011, pp. 529–531.
[20] Brezis, E.S., "Focal Randomization: An Optimal Mechanism for the Evaluation of R&D Projects," *Science and Public Policy*, Vol. 34, No. 10, 2007, pp. 691–698.
[21] ESF, "Peer Review: Its Present and Future State", conference report, Prague, 12–13 October 2006. As of 19 March 2013: http://www.esf.org/activities/science-policy/corporate-science-policy-initiatives/peer-review-2006.html

EFFECTIVENESS

Outcome

This method results in a large degree of uncertainty around its outcome, depending on how it is framed.

Innovation

'Focal randomisation' is designed to fund a higher proportion of projects where uncertainty around return value is high (for instance, inventions) compared to the current peer review system.

Credibility

In light of the finding that some degree of randomness exists in decisions based on traditional peer review,[22] it is possible that random allocation would gain more traction as a credible method if framed accordingly. Random allocation eliminates biases linked to traditional peer review, yet may not capture deserving scientists, therefore reducing credibility.[23]

Accountability

This method does not appear to feature an element of accountability. It could be argued that because it involves no subjective judgement, it benefits from enhanced transparency.

EFFICIENCY

Applicant burden

The burden on applicants remains the same as for any call for funding; researchers need to put in the same effort as in a regular application, since applications may have to pass a certain quality threshold to be included in the lottery.

Funder burden

Depending on how major a part the chance element plays in funding allocation, the funding body may still need to appoint a panel of reviewers for the initial triage between applications that will be funded, those which will not, and those for which a random allocation mechanism is to be set up.

22 Graves, N., A.G. Barnett and P. Clarke, "Funding Grant Proposals for Scientific Research: Retrospective Analysis of Scores by Members of Grant Review Panel," BMJ, Vol. 343, 2011, pp. 1–8.

23 Ioannidis, J.P.A., "More Time for Research: Fund People not Projects," *Nature*, Vol. 477, 2011, pp. 529–531.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

References and Additional Resources

Summary and introduction

AMRC, "Principles of Peer Review". As of 19 March 2013: http://www.amrc.org.uk/research-resources_peer-review

Azoulay, P., "Turn the scientific method on ourselves," *Nature*, Vol. 484, 2012, pp. 31–32.

Birukou, A., J. Rushton Wakeling, C. Bartolini, F. Casati, M. Marchese, K. Mirylenka, N. Osman, A. Ragone, C. Sierra and A. Wassef, "Alternatives to Peer Review: Novel Approaches for Research Evaluation", *Frontiers in Computational Neuroscience*, Vol. 5, Art. 56, December 2011, pp. 1–12.

Global Research Council, "Statement of Principles for Scientific Merit Review". As of 19 March 2013: http://www.globalresearchcouncil.org/statement-principles-scientific-merit-review

Ismail, S., *Participatory Health Research: International Observatory on Health Research Systems*, Santa Monica, Calif.: RAND Corporation, TR-667-DH, 2009.

Ismail, S., A. Farrands and S. Wooding, *Evaluating Grant Peer Review in the Health Sciences – A Review of the Literature*, Santa Monica, Calif.: RAND Corporation, TR-742-DH, 2009.

Milestones

Davis, L. and J. Davis, "How Effective Are Prizes as Incentives to Innovation? Evidence From Three 20th Century Contests", DRUID Summer Conference on Industrial Dynamics, Innovation, and Development, Elsinore, Denmark, 7 May 2004.

Erren, T.C., "Prizes to Solve Problems in and Beyond Medicine, Big and Small: It Can Work", *Medical Hypotheses*, Vol. 68, No. 4, 2007, pp. 732–734.

Juvenile Diabetes Research Foundation International. As of 19 March 2013: http://www.jdrf.org

Marchant, R., "Managing Prize Systems: Some Thoughts on the Options", *Knowledge Ecology Studies*, Vol. 2, March 2008.

National Human Genome Research Institute. As of 19 March 2013: http://www.genome.gov

Unconstrained excellence

Azoulay, P., J.S. Graff Zivin, and G. Manso, "Incentives and Creativity: Evidence from the Academic Life Sciences," *NBER Working Paper*, No. 15466, 2011. As of 19 March 2013: http://www.nber.org/papers/w15466.pdf?new_window=1

DNRF, "What is a Center of Excellence?". As of 19 March 2013: http://www.dg.dk/en/centers-of-excellence-2/what-is-a-center-of-excellence/

Foundational Questions Institute, "About FQXi". As of 19 March 2013: http://www.fqxi.org/about

HHMI, "Frequently Asked Questions About the HHMI Investigator Program". As of 19 March 2013: http://www.hhmi.org/research/investigators/investigator_faq.html#review

Ioannidis, J.P.A., "More Time for Research: Fund People not Projects," *Nature*, Vol. 477, 2011, pp. 529–531.

MacArthur Foundation, "About the Macarthur Fellows Program". As of 19 March 2013: http://www.macfound.org/pages/about-macarthur-fellows-program/

Venant, E., "MacArthur's Award for Genius Fellowship: The Big Honor Bestowed on Scientists, Humanists and Artists is Prestigious and Comes with No Strings Attached," *Los Angeles Times*, 25th December 1989, p. 1.

Sandpit

Berezin, A. "The Perils of Centralized Research Funding Systems", *Knowledge, Technology and Policy*, Vol. 11, No. 3, 1998, pp.5–26.

Bornmann, L. and H.D. Daniel, "Selection of Research Fellowship Recipients by Committee Peer Review. Reliability, Fairness and Predictive Validity of Board of Trustees' Decisions", *Scientometrics,* Vol. 63, No. 2, 2005, pp. 297–320.

Engineering and Physical Sciences Research Council. As of 19 March 2013: http://www.epsrc.ac.uk

Heinze, T. "How to Sponsor Ground-breaking Research: a Comparison of Funding Schemes", *Science and Public Policy*, Vol. 35, No.5, 2008, pp. 302–318.

Lee, C., "Perspective: Peer Review of Interdisciplinary Scientific Papers", 2006. As of 19 March 2013: http://blogs.nature.com/peer-to-peer/2006/06/perspective_peer_review_of_int.html

Prendergast, P.J., S.H. Brown and J.R. Britton, "Research Programmes that Promote Novel, Ambitious, Unconventional and High-risk Research: an Analysis". *Industry and Higher Education*, Vol. 22, No. 4, 2008, pp. 215–221.

Shimada, K., M. Akagi, T. Kazamaki and S. Kobayashi, "Designing a Proposal Review Process to Facilitate Interdisciplinary Research", *Research Evaluation*, Vol. 16, No. 1, 2007, pp. 13–21.

Takeda-Techno Entrepreneurship Award. As of 19 March 2013: http://www.takeda-foundation.jp/en/award/tech/info/index.html

Conditional funding

CFHI. As of 19 March 2013: http://www.cfhi-fcass.ca/Home.aspx

MNDA, "Healthcare Research Grants". As of 19 March 2013: http://www.mndassociation.org/research/for-researchers/research-grants/Type+of+grant/healthcare-research-grants

NHMRC, "NHMRC Partnerships for Better Health: Partnership Centres Peer Review Guidelines – 2012–13", 2012. As of 19 March 2013: https://www.nhmrc.gov.au/_files_nhmrc/file/grants/apply/strategic/partnership_centre_peer_review_guidelines_121011.pdf

Mentored

Braben, D.W., *Scientific Freedom: The Elixir of Civilization*, Hoboken, N.J.: John Wiley & Sons, Inc., 2008.

OBI. As of 19 March 2013: http://www.braininstitute.ca/

Portfolio

Berezin, A., "The Perils of Centralized Research Funding Systems", *Knowledge, Technology and Policy*, Vol. 11, No. 3, 1998, pp. 5–26.

Braben, D.W., *Pioneering Research: A Risk Worth Taking*, Hoboken, NJ: John Wiley & Sons, 2004.

Grant, J., and L. Allen, "Evaluating High Risk Research: an Assessment of the Wellcome Trust's Sir Henry Wellcome Commemorative Awards for Innovative Research," *Research Evaluation*, Vol. 8, No. 3, 1999, pp. 201–204.

Heinze, T., "How to Sponsor Ground-breaking Research: a Comparison of Funding Schemes", *Science and Public Policy*, Vol. 35, No. 5, 2008, pp. 302–318.

Howard Hughes Medical Institute. As of 19 March 2013: http://www.hhmi.org

Institute of Medicine (IOM), *Committee on Policies for Allocating Health Sciences Research Funds, Funding Health Sciences Research: A Strategy to Restore Balance*, Washington, DC: National Academies Press, 1990.

National Institutes of Health (NIH), "2007–2008 Peer Review Self-Study: Final Draft", 2008. As of 19 March 2013: http://enhancing-peer-review.nih.gov/meetings/NIHPeerReviewReportFINALDRAFT.pdf

National Institutes of Health (NIH), "Roadmap for Medical Research". As of 19 March 2013: http://nihroadmap.nih.gov

Poulin, B.J. and R. Gordon, "How to Organize Science Funding: The New Canadian Institutes for Health Research, an Opportunity to Increase Innovation", *Canadian Public Policy–Analyse De Politiques*, Vol. 27, No. 1, 2001.

Prendergast, P.J., S.H. Brown and J.R. Britton, "Research Programmes that Promote Novel, Ambitious, Unconventional and High-risk Research: an Analysis", *Industry and Higher Education*, Vol. 22, No. 4, 2008, pp. 215–221.

Robert Wood Johnson Foundation, "2008 Assessment Report". As of 19 March 2013: http://www.rwjf.org/content/dam/web-assets/2008/12/rwjf-assessment-report-2008

Srivastava, C.V., N.D. Towery and B. Zuckerman, "Challenges and Opportunities for Research Portfolio Analysis, Management, and Evaluation", *Research Evaluation*, Vol. 16, No. 3, 2007, pp. 152–156.

Ad hoc/discretionary

Bloom, F.E. and M.A. Randolph, "Funding Health Sciences Research: A Strategy to Restore Balance", Institute of Medicine, 1990. 0309043433, National Academies Press.

Bolduc, K., E. Buteau, G. Laughlin, R. Ragin and J.A. Ross, "Beyond the Rhetoric: Foundation Strategy". As of 19 March 2013: http://www.effectivephilanthropy.org

Hackett, E.J. and D.E. Chubin, "Peer Review for the 21st Century: Applications to Education Research", National Research Council Workshop, Washington, DC, 31 July 2003.

Michael J. Fox Foundation for Parkinson's research, "Rapid response innovation awards", 2013. As of 19 March 2013: https://www.michaeljfox.org/research/grant-detail.php?id=3#crumb

National Academies of Science. As of 19 March 2013: http://www.nas.edu

National Science Foundation. As of 19 March 2013: http://www.nsf.gov

Natural Environment Research Council, "UK IODP Rapid response grant", 2013. As of 19 March 2013: http://www.nerc.ac.uk/research/programmes/ukiodp/grants/rapidgrant.asp

Natural Hazards Center, "Quick Response Grant Program Guidelines: Postdisaster Studies Sponsored by the Natural Hazards Center", 2013. As of 19 March 2013: http://www.colorado.edu/hazards/research/qr/guidelines.html

National Institutes of Health (NIH), "2007–2008 Peer Review Self-Study: Final Draft", 2008. As of 19 March 2013: http://enhancing-peer-review.nih.gov/meetings/NIHPeerReviewReportFINALDRAFT.pdf

William and Flora Hewlett Foundation, Special Projects and Initiatives. As of 19 March 2013: http://www.hewlett.org/programs/special-projects

William J. & Dorothy K. O'Neill Foundation, "Rapid Response Grants", 2012. As of 19 March 2013: http://www.oneillfdn.org/_dpl/node/79

Ex-post awards/prizes

DARPA Urban Challenge. As of 19 March 2013: http://archive.darpa.mil/grandchallenge/

Davidian, K., "Prizes, Prize Culture, and NASA's Centennial Challenges". As of 19 March 2013: http://commercialspace.pbworks.com/f/Prizes,+Prize+Culture,+and+NASA%27s+Centennial+Challenges.pdf

Davis, L. and J. Davis, "How Effective Are Prizes as Incentives to Innovation? Evidence From Three 20th Century Contests", DRUID Summer Conference on Industrial Dynamics, Innovation, and Development, Elsinore, Denmark, 7 May 2004.

Erren, T.C., "Prizes to Solve Problems in and Beyond Medicine, Big and Small: It Can Work", *Medical Hypotheses*, Vol. 68, No. 4, 2007, pp. 732–734.

Knowledge Ecology International, "Prizes to Stimulate Innovation". As of 19 March 2013: http://www.keionline.org

Macauley, M.K., "Advantages and Disadvantages of Prizes in a Portfolio of Financial Incentives for Space Activities", *Space Policy*, Vol. 21, No. 2, 2005, pp. 121–128.

Marchant, R., "Managing Prize Systems: Some Thoughts on the Options", *Knowledge Ecology Studies,* Vol. 2, March 2008.

Methuselah Foundation, "MPrize". As of 19 March 2013: http://www.mprize.org

Wei, M., "Should Prizes Replace Patents? A Critique of the Medical Innovation Prize Act of 2005", *Boston University Journal of Science and Technology Law*, Vol. 13, No. 1, 2007.

Renewal

British Heart Foundation. As of 19 March 2013: http://www.bhf.org.uk

Huffman, W.E. and R.E. Just, "Setting Efficient Incentives for Agricultural Research: Lessons from Principal-agent Theory", *American Journal of Agricultural Economics*, Vol. 82, No. 4, November 2000, pp. 828–841.

Kavanagh, E. (ed), "Letters to the Editor – NIH Funding: What Does the Future Look Like?" *Science*, Vol. 316, 13 April 2007.

Mandel, H.G. and E.S. Vesell, "From Progress to Regression: Biomedical Research Funding", *J Clin Invest*, Vol. 114, No. 7, 1 October 2004, pp. 872–876.

Nathan, D.G. and J.D. Wilson, "Clinical Research and the NIH – a Report Card", *New England Journal of Medicine*, Vol. 349, No. 19, 6 November 2003, pp. 1860–1865.

Single person

Bornmann, L. and H.D. Daniel, "Selection of Research Fellowship Recipients by Committee Peer Review. Reliability, Fairness and Predictive Validity of Board of Trustees' Decisions", *Scientometrics,* Vol. 63, No. 2, 2005, pp. 297–320.

DARPA. As of 19 March 2013: http://www.darpa.mil

Grand Challenges in Global Health, "How Grand Challenges Explorations Grants are Selected," 2012. As of 19 March 2013: http://www.grandchallenges.org/Explorations/Pages/GrantProcess.aspx

Graves, N., A.G. Barnett and P. Clarke, "Funding Grant Proposals for Scientific Research: Retrospective Analysis of Scores by Members of Grant Review Panel," BMJ, Vol. 343, 2011, pp. 1–8.

Hackett, E.J. and D.E. Chubin, "Peer Review for the 21st Century: Applications to Education Research", National Research Council Workshop, Washington, DC, 31 July 2003.

Langfeldt, L., "Expert Panels Evaluating Research: Decision-making and Sources of Bias", *Research Evaluation*, Vol. 13, No. 1, 2004, pp. 51–62.

Langfeldt, L., "The Decision-making Constraints and Processes of Grant Peer Review, and their Effects on the Review Outcome", *Social Studies of Science*, 2001, pp. 820–841.

University College London, "Provost's Venture Prize". As of 19 March 2013: http://www.ucl.ac.uk/research/venture-prize

Interdisciplinary/multi-stakeholder committee

Canadian Institutes of Health, "Community Reviewers: Involving the Canadian Public in the CIHR Peer Review Committees". As of 19 March 2013: http://www.cihr-irsc.gc.ca/e/31928.html

Canadian Nurses Foundation, Nursing Care Partnership, "Executive Merit Review Panel: Terms of Reference" (as of April 2011).

Klein, J.T., "Evaluation of Interdisciplinary and Transdisciplinary Research: a Literature Review". *American Journal of Preventive Medicine*, Vol. 35, No. 2 Suppl, 2008, pp. S116–123.

Lamont, M., G. Mallard and J. Guetzkow, "Beyond Blind Faith: Overcoming the Obstacles to Interdisciplinary Evaluation", *Research Evaluation*, Vol. 15, No. 1, 2006, pp. 43–55.

Langfeldt, L., "Expert Panels Evaluating Research: Decision-making and Sources of Bias", *Research Evaluation*, Vol. 13, No. 1, 2004, pp. 51–62.

Langfeldt, L., "The Policy Challenges of Peer Review: Managing Bias, Conflict of Interests and Interdisciplinary Assessments", *Research Evaluation*, Vol. 15, No. 1, 2006, pp. 31–41.

Laudel, G., "The Art of Getting Funded: How Scientists Adapt to their Funding Conditions", *Science and Public Policy*, Vol. 33, No. 7, 2006a, pp. 489–504.

Laudel, G., "Conclave in the Tower of Babel: How Peers Review Interdisciplinary Research Proposals", *Research Evaluation*, Vol. 15, No. 1, 2006b, pp. 57–68.

Lee, C., "Perspective: Peer Review of Interdisciplinary Scientific Papers", 2006. As of 19 March 2013: http://blogs.nature.com/peer-to-peer/2006/06/perspective_peer_review_of_int.html

Lomas, J., "Using Linkage and Exchange to Move Research into Policy at a Canadian Foundation", *Health Affairs*, Vol. 19, No. 3, 2000, pp. 236–240.

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, Committee on Science, Engineering, and Public Policy, *Facilitating Interdisciplinary Research*, Washington, DC: The National Academies Press, 2004.

National Institutes of Health (NIH), "2007–2008 Peer Review Self-Study: Final Draft", 2008. As of 19 March 2013: http://enhancing-peer-review.nih.gov/meetings/NIHPeerReviewReportFINALDRAFT.pdf

National Science Foundation, "Grant Proposal Guide, Ch. III – NSF Proposal Processing and Review". As of 19 March 2013: http://www.nsf.gov/pubs/gpg/nsf04_23/3.jsp

Nightingale, P. and A. Scott, "Peer Review and the Relevance Gap: Ten Suggestions for Policy-makers", *Science and Public Policy*, Vol. 34, No. 8, 2007, pp. 543–553.

Allocation by score

Asthma UK, "Lay Involvement". As of 19 March 2013: http://www.asthma.org.uk/research-lay-involvement

British Academy, "Peer Review", 2012. As of 19 March 2013: http://www.britac.ac.uk/funding/peer-review.cfm#fback

CIHR, "CIHR Instructions for Chairs", 2011. As of 19 March 2013: http://www.cihr-irsc.gc.ca/e/40211.html

NIH, "Peer Review Process". As of 19 March 2013: http://grants.nih.gov/grants/peer_review_process.htm

Online/iterative

CIHR, "CIHR Instructions for Committee Members – Structured, Remote Review", 2012. As of 19 March 2013: http://www.cihr-irsc.gc.ca/e/44084.html

Dalal, S., D. Khodyakov, R. Srinivasan, S. Straus and J. Adams, "ExpertLens: A System for Eliciting Opinions from a Large Pool of Non-collocated Experts with Diverse Knowledge," *Technological Forecasting and Social Change*, Vol. 78, Issue 8, 2011, pp. 1426–1444.

Holliday, C., and M. Robotin, "The Delphi Process: a Solution for Reviewing Novel Grant Applications," *International Journal of General Medicine*, Vol. 2010, No. 3, 2010, pp. 225–230. As of 19 March 2013: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2934605/pdf/ijgm-3-225.pdf

Ismail, S., "Delphi Exercises", 2009, in Ling, T., and L. Villalba van Dijk, *Performance Audit Handbook: Routes to effective evaluation*, Santa Monica, Calif.: RAND Corporation, TR-788-RE.

Random

Brezis, E.S., "Focal Randomization: An Optimal Mechanism for the Evaluation of R&D Projects," *Science and Public Policy*, Vol. 34, No. 10, 2007, pp. 691–698.

ESF, "Peer Review: Its Present and Future State", conference report, Prague, 12–13 October 2006. As of 19 March 2013: http://www.esf.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/be_user/CEO_Unit/MO_FORA/MOFORUM_Peer_Review/Peer%20Review%20Conference%20Report.pdf&t=1366211384&hash=e1664c7df29be591b53f8bb223f917abdf84a28d

Graves, N., A.G. Barnett and P. Clarke, "Funding Grant Proposals for Scientific Research: Retrospective Analysis of Scores by Members of Grant Review Panel," *BMJ*, Vol. 343, 2011, pp. 1–8.

Ioannidis, J.P.A., "More Time for Research: Fund People not Projects," *Nature*, Vol. 477, 2011, pp. 529–531.

RAND EUROPE

This product is part of the RAND Corporation report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.