THE THINK TANK
DEA
ADVANCING KNOWLEDGE

Research funders' efforts to support risk-taking in science

Selected case studies

This background report was developed by the Think Tank DEA in collaboration with and with co-funding from The Independent Research Council Denmark in preparation for the development of their joint report "Risikovillig forskningsfinansiering" ("Risk-taking in science funding").

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About the report

This background report presents short descriptions of five cases of research funders and/or research funding programs with a particular focus on promoting risk-taking in science. The cases were identified via desk research and selected so as to illustrate a variety of themes covered in the joint report "Risikovillig forskningsfinansiering" ("Risk-taking in science funding") by the Think Tank DEA and The Independent Research Council Denmark. Abbreviated versions of the five cases have been included in the joint report.

The five cases are:

- The TERVA Academy Program under the Academy of Finland, Finland
- Research grants under the European Research Council (ERC), European Commission
- The HHMI Investigator Program under the Howard Hughes Medical Institute (HHMI), U.S.
- The VILLUM Experiment under the VILLUM Foundation, Denmark
- The SGER mechanism under the National Science Foundation (NSF), U.S.

The case descriptions included in this background report are primarily based on information available from funder and program websites, publicly available reports and evaluations, and peer-reviewed publications on the funders and programs covered in the case studies. In three of the cases (TERVA, ERC and VILLUM Fonden), these secondary data sources were supplemented with interviews with key persons employed by the funding organizations described in the case studies. Case descriptions were sent to interviewees for factual accuracy checks and approval of quotes derived from the interviews. The remaining two cases (HHMI and NSF) are solely based on publicly available secondary data sources.

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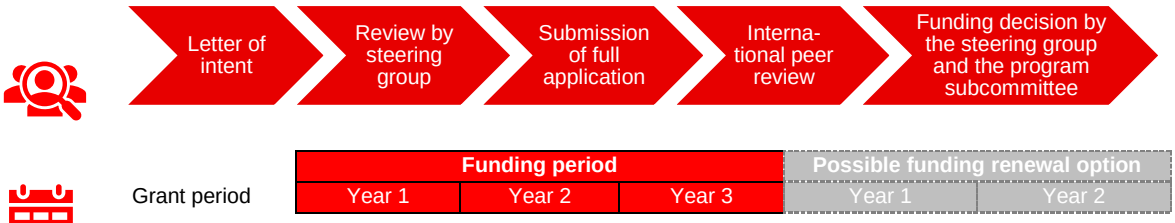
1. The TERVA Academy Program – from pilot project to full-scale program

Box 1.1. The TERVA Program in brief

Program under the Academy of Finland which targets "high-risk, high-gain" research projects that challenge existing scientific paradigms by pursuing novel ideas, approaches, methods, interdisciplinary links, or further development of early-stage research results. Risks must be motivated in terms of the potentially significant positive effects of the proposed research on public health. TERVA funds research aimed at all major diseases that pose a threat to public health. Funding can be applied for by consortia consisting of at least two research teams representing at least three research fields.

The funding provided by the TERVA program from the Academy of Finland and from four collaborating foundations amounts to a maximum of 2 million euros per consortium and up to 1.3 million euros per consortium subproject over a 3-year period. There are preliminary plans in place that the 3-year funding period would be followed by a 2-year funding period to be implemented jointly between the Academy and the foundations. The funding covers project-related costs.



The program was launched based on a high-risk funding trial carried out by the Academy of Finland's Research Council for Health in 2014–2016. The research projects supported in the funding trial were positively evaluated in 2015, where almost all projects were described as competitive and strong research projects. The TERVA-program is still running and is too young for its impact to have been reliably documented.

About the funder

The Academy of Finland is a governmental funding body for scientific research in Finland, which yearly funds Finnish research activities with over 450 million EUR The Academy consists of three research councils: 1) Biosciences, Health and Environment[1], 2) Culture and Society and 3) Natural Sciences and Engineering.

About the TERVA program

Although there is much research aimed at diseases, there are still unsolved questions concerning many diseases. With the intention of addressing these unsolved questions, the Health from Science (TERVA) Academy Program aims at promoting "high-risk, high-gain" research. They elaborate on their homepage: "*From the viewpoint of public health promotion, significant scientific breakthroughs often emerge from unexpected results that are firmly based on high-quality basic research and justified risk-taking as regards research designs"* (Academy of Finland 2017a).

[1] The Research Council for Health was merged into the Research Council for Biosciences, Health and Environment in 2019.

At the start of the TERVA program, the Chair of the Research Council for Health from the Academy of Finland highlighted a challenge regarding conditions for risk-taking: *"As funding for research becomes increasingly scarce and the competition becomes tougher, funders tend to go for the safe bets"* (Academy of Finland 2017b). According to him, this challenge calls for funds available for greater risk-taking in science. TERVA therefore focuses on supporting research that challenges or extends existing scientific paradigms by exploring novel approaches, methods, or interdisciplinary links, or further develops early-stage research results.

The projects must involve open-minded approaches at the frontiers of knowledge – and they cannot be continuations of existing projects. Applicants must define the risky elements in their project, and the risks should be motivated in terms of potentially significant effects on the promotion of public health. TERVA funds research aimed at all major diseases affecting public health. The scope of the program has deliberately not been limited – aside from the exclusion of so-called "orphan diseases."

The program also aims at supporting new forms of collaboration between research funding bodies that support disease research to achieve a wider, joint funding base and coordinate funding efforts. The foundations involved in the TERVA program are the Finnish Brain Foundation, the Foundation for Pediatric Research, the Finnish Medical Foundation and the Cancer Foundation. In the memorandum of the program (Academy of Finland 2017a), the collaboration is described as follows: *"Within the TERVA Academy Programme, the Academy and the foundations involved join forces with a view to funding the most promising new research projects that include justifiable risks and that promote public health"*. As the Program Manager of TERVA pointed out in an interview (Sara Illman, Program Manager 2019): *"It's a 'win-win situation' for both us and the other organizations as we pool our resources, which enables us to do more than we could individually."* The cooperation with other foundations is also undertaken with the purpose of strengthening the visibility of funded projects outside the academic community.

TERVA provides support for consortia consisting of at least two research groups representing at least three research fields. Thus, the program does not support individuals or individual research groups, but broad, interdisciplinary collaborations.

The program provides grants of up to 2 million EUR per consortium over a period of three years, and up to 1.3 million EUR per consortium subproject. The success rate was 6% in 2017 for the 2018-2020 funding period. The funding covers project-related costs. TERVA distributes a total of DKK 7 million EUR from 2018 to 2020, while another 1.9 million EUR come from other funding organizations associated with the program.

At the moment, it is not possible to receive a funding renewal. There are, however, preliminary plans in place that the three-year funding period would be followed by a two-year funding period to be implemented jointly between the Academy and the collaborating foundations.

The implementation and results of the program are planned to be evaluated upon its completion. The evaluation will, among other things, consider the following issues: attainment of program objectives, program implementation, and evidence of impacts supported by the program.

On the origins of the program

The TERVA program is run by a steering group composed of members of the Academy's research councils, representatives of the foundations that collaborate with the program, and selected expert members. TERVA was developed based on a funding experiment initiated after an international evaluation by the Academy of Finland. In the evaluation, the Academy was recommended to be more explicit about how they supported risk-taking in their research funding and whether the Academy had specific instruments to support the development of breakthroughs in research. The Research Council for Health addressed this recommendation through a trial initiated in 2014. The trial was based on a selection of ten applicants from the Academy's other funding instruments that were considered to be of excellent scientific quality but high-risk, and which had not received grants during the 2014-calls. The research projects received a 16-month grant to pursue their risky idea. In the 2014-application process, international evaluators provided feedback on research plans and recommendations to improve projects, based on which the applicants built their research strategy. Nine applicants reapplied after the 16 months and their progress was assessed through international peer review. Several projects were considered competitive and strong research projects. Six applicants were granted an extension of their grant for two to four years, depending on the original funding instrument they had applied under.

Based on the positive experience gained from the trial in 2016, the TERVA program was launched with its first call in 2017, which provided funding for research projects to be pursued during the period 2018-2020.

Selection of grantees

The TERVA Academy Program had a two-stage call. In the first stage, applicants prepared letters of intent according to the Academy's guidelines. The guidelines highlighted that the letter of intent: "*must show the project's novelty value from the perspective of science renewal and include justifications for the required risk component in terms of the potentially significant impacts on the promotion of public health"* (Academy of Finland 2017a).

A steering group, extended with scientific experts, and the program subcommittee decided which projects proceeded to the second call stage. Applicants invited to submit full applications had to prepare a complete research plan and submit it via the Academy's online application system. The applications were then reviewed by international peer reviewers, who paid particular attention to the scientific quality of the application and the applicant. An interview (with Sara Illman, Program Manager 2019) reveals that reviewers were experts on a general level. They were experienced and have performed numerous reviews for the Academy and/or other research funders. Their joint expertise was intended to cover the topics of all applications. It was up to applicants to explain the possible impact of the proposed project, so an expert on a general level could understand it.

Box 1.2. TERVA criteria for applicants

- **Quality:** The quality refers to the quality of the application.
- **Impact:** Impact is defined regarding the potentially significant impacts on the promotion of public health.
- **Renewal:** The novelty value is assessed based on its potential to renew scientific agendas/approaches.
- **Boldness/riskiness:** It is up to applicants to define the risks taken in the project and the possible gains.

Source: Academy of Finland (2017a)

2. ERC Grants – balancing excellence and risk-taking

Box 2.2. ERC research grants in brief

The European Research Council (ERC) was established as part of the European Commission's Framework Program for Research and Technological Development (FP7) in 2007 with the aim of providing attractive, long-term research project funding to support excellent investigators and their teams in their pursuit of high-gain/high-risk research. Its grant portfolio includes *ERC Starting Grants* and *ERC Consolidator Grants* for young researchers at the stage of establishing and leading their first research team or program, *ERC Advanced Grants* targeting the population of researchers who have already established themselves as being independent research leaders in their own right, and *ERC Synergy Grants* aimed not at individuals but instead at small groups of principal investigators and their teams to bring together complementary skills, knowledge, and resources to jointly address research problems at the frontier of knowledge, going beyond what individual investigators can achieve on their own. The grants are open to all fields of research, and there are no thematic priorities; instead the ERC pursues an investigator-driven, "bottom-up" process to select grant recipients. Grants are portable, i.e. can be taken with the principal investigator to another institution, in order to empower researchers with great ideas and induce structural transformation at the institutional level.

Grant sizes vary depending on the type of grant but range from up to 1.5 million EUR for ERC Starting Grants to up to 10 million EUR for Synergy Grants.

The evaluation process depends on the type of grant, but typically involves an eligbility check, an evaluation of the proposals by international peer reviewers, and assessment and selection by panels appointed by the ERC's Scientific Council, supported by interviews with selected applicants. Applications for Starting, Consolidator and Advanced Grants are evaluated using a two-step evaluation procedure, and Synergy Grant applications are subjected to a three-step evaluation.

Type of grant	**Funding period**					
Starting & Consolidator	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	
Advanced	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	
Synergy	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs

A study of the peer review processes at the ERC found conservative elements which worked against the ERC's aim to promote frontier research, particularly when proposals were deemed to be potentially novel but which also involved risks that were difficult to assess within existing scientific paradigms. However, in the most recent evaluation of completed ERC projects, 16% of the projects were deemed to have resulted in scientific breakthroughs, and an additional 59% to have made a major contribution to science. Close to two thirds of the projects were said to have opened up a promising new research agenda or possible paradigm shift, and two thirds were characterized by reviewers as "high-risk/high-gain" proposals at the time of the grant decision. Generally speaking, the ERC grants have been associated with highly novel science, including as seen e.g. in the latest Nobel Prize announcement on Physiology or Medicine. In addition, the ERC grant schemes can be seen as an instrument to fight conservatism at institutional level, by empowering early stage grantees to make hiring and spending decisions within institutions that would otherwise limit such decisions to very senior academic staff. These early stage researchers base their decisions on their own research agenda as outlined in the ERC project.

About the funder

The European Research Council (ERC) was established as part of the European Commission's Framework Program for Research and Technological Development (FP7) in 2007 with the aim of providing attractive, long-term research project funding to support excellent investigators and their research teams to pursue high-gain/high-risk "frontier research".

As described by Gronbaek (2003), the ERC was established at least in part as a reaction against other research funding organizations' national focus and the applied and mission-oriented nature of research funding provided under the EU's Framework Programs. The creation of the ERC was aided by a significant and broad base of support, including from the scientific community, despite resistance from some EU Member States to the idea of allocating EU funds to basic research (König 2017).

The total ERC budget is over 13 billion EUR during the period 2014-2020, with funding provided by the Horizon 2020 Framework Program. The funding schemes from the ERC have grown to become some of the most prestigious research grants in Europe, which can be attributed at least in part to the council's sole on scientific excellence as the sole criterion for awarding grants.

In formulating the actual schemes of the ERC in 2007, the Council had a clear ambition to challenge the aversion to risk inherent in public governance and to promote high-risk "frontier research". A the same time, as a public research council – funded by Member States of the EU – the ERC has an obligation to taxpayers to make sound investments and manage risk responsibly, with a minimum of unsuccessful investment.

The Council could have been subject to the same bureaucratic processes as the rest of FP7, where project milestones and deliverables generally carry heavy weight in the assessment of applications. The ERC was ultimately awarded substantial autonomy in developing its strategy and evaluation and decision-making processes (Luukkonen 2012). The ERC chose to launch schemes designed by scientists, with scientific excellence as the sole criterion, and based on scientific peer review. The return to peer review – in the context of the framework programs for research and technological development – was an attempt by the ERC to both promote excellence and induce more risk-taking in the evaluation of proposals by allowing uncertain developments in the funded projects, avoiding milestones and deliverables, and putting scientists rather than public servants in the driver's seat of the review process.

The open calls for all fields of research and the focus on providing funding for individual principal investigators also represented a shift away from the mission-oriented research grants for consortia consisting of both research institutions and private companies, which had hitherto been provided by the EU's framework programs.

About the main types[2] of ERC grants

The ERC offers *ERC Starting Grants* and *ERC Consolidator Grants* for researchers at the stage of establishing and leading their first research team or program, and *ERC Advanced Grants* targeting the population of researchers who have already established themselves as independent research leaders in their own right (European Commission 2007). In 2011, the Council added *ERC Synergy Grants* aimed

[2] The ERC also offers Proof of Concept Grants, which are not described in this background report.

not at individuals but instead small groups of principal investigators and their teams to bring together complementary skills, knowledge, and resources, in order to jointly address research problems at the frontier of knowledge, going beyond what individual investigators can achieve on their own. The grants provide long-term funding for a period of up to five years for the Starting, Consolidator and Advanced Grants, and up to six years for the Synergy Grants (European Commission 2019).

An ERC grant is awarded to the institution that engages and hosts the principal investigator, with the requirement that the institution offers appropriate conditions for the investigator to carry out the ERC-funded research project. Principal investigators may request to transfer their grant to a different host institution at any time. Public or private institutions, including universities, research organizations and the like can host the principal investigator and his or her team. The maximum size and duration of ERC grant varies by grant type, as indicated by table 2.1.

Table 2.1. Maximum size and duration of selected ERC grants

Grant	Maximum size and duration *
Starting Grant	Up to 1.5 million EUR for a period of 5 years **
Consolidator Grant	Up to 2 million EUR for a period of 5 years **
Advanced Grant	Up to 2.5 million EUR for a period of 5 years **
Synergy Grant	Up to 10 million EUR for a period of 6 years ***

Source: The European Research Council; * An ERC grant can cover up to 100% of the total eligible direct costs of the research plus a contribution of 25% of the total eligible costs towards indirect costs; ** An additional 1 million EUR can be made available to cover eligible “start-up” costs for researchers moving from a third country to the EU or an associated country and/or the purchase of major equipment and/or access to large facilities and/or other major experimental and field work costs; *** An additional 4 million EUR can be requested in the proposal in total to cover eligible 'start-up' costs for Principal Investigators moving to the EU or an Associated Country from elsewhere as a consequence of receiving an ERC grant and/or the purchase of major equipment and/or access to large facilities.

Eligibility criteria for principal investigators

ERC grant applications can only be submitted in response to a call for proposals. The ERC has yearly calls which are open to applicants and proposals from all scientific fields. The ERC's research grants operate on an investigator-driven, 'bottom-up' basis without predetermined priorities, meaning that applicants are responsible for identifying relevant research themes and agendas.

Researchers from all over the world are eligible to apply, provided that the host institution is situated in an EU Member State or Associated Country. This, however, does not apply to the team members in any principal investigator’s team or to one of the principal investigators in a Synergy Grant Group, who may be based outside of the EU or an Associated Country. Principal Investigators may be of any age and nationality and may reside in any country in the world at the time of the application (European Commission 2019).

Table 3.2. Eligibility requirements for selected ERC grants

Starting Grant	Consolidator Grant	Advanced Grant	Synergy Grant
2-7 years of experience since completion of PhD A scientific track record showing great promise	7-12 years of experience since completion of PhD A scientific track record showing great promise	Active researchers A track-record of significant research achievements in the last 10 years	A group of 2-4 PIs* working together to tackle ambitious research problems PIs must present an early achievement track-record or a ten-year track-record,

An excellent research proposal	An excellent research proposal	Should be exceptional leaders in terms of originality and significance of their research contributions	whichever is most appropriate

Source: The European Research Council; * PI = Principal Investigator. For more information on requirements of applicants, see European Commission (2019).

The research grants from the ERC are targeted at different career stages. For instance, as illustrated in table 3.2, Starting and Consolidator Grants are for early career researchers.

Principal investigators funded by the ERC are required to spend a minimum percentage of their working time on the ERC project and in an EU Member State or Associated Country. As illustrated by table 4.3, the required level of commitment varies between grant schemes

Table 4.3. Minimum commitment of working time spent on ERC project

	Starting Grant	Consolidator Grant	Advanced Grant	Synergy Grant
On the funded project	50%	40%	30%	30% for each PI *
In an EU Member State or Associated Country	50%	50%	50%	50% for each PI engaged and hosted by an institution in the EU or Associated Countries

Source: The European Research Council; * PI = Principal Investigator.

ERC grants have traditionally been awarded solely on the basis of scientific excellence, as determined by international peer reviewers and described in the ERC Work Programme 2020 as follows:

"For all ERC frontier research grants, scientific excellence is the sole criterion of evaluation. It will be applied in conjunction to the evaluation of both: the ground-breaking nature, ambition and feasibility of the research project; and the intellectual capacity, creativity and commitment of the Principal Investigator." (European Commission 2019, p. 34)

As such, the ERC explicitly encourages "frontier research" (ERC Scientific Council 2019) in the form of high-risk, high-reward proposals with the potential to generate scientific breakthroughs, should the funded research be successful. Grants are intended to be flexible and cover all costs for the funded project. The relatively long-term and sizeable nature of the grants is intended to foster creativity and promote "pioneering proposals addressing new and emerging fields of research or proposals introducing unconventional, innovative approaches and scientific inventions" (ERC Scientific Council 2019, p. 8). Indeed, Laudel and Gläser (2014, p. 2014) argued that "'ERC-type' funding schemes – funding schemes that offer large amounts of resources that can be flexibly used for a relatively longtime (five years and more) constitute an institutional innovation that increases the diversity of conditions for research."

Peer reviewers are responsible for assessing and scoring proposals, and the proposals that pass the quality threshold are ranked according to their score. Only the highest ranked proposals are offered an ERC grant, until a given call's budget has been used. For each call, peer review panels covering the full spectrum of scientific fields are appointed by the ERC Scientific Council.

To become eligible for individual grants, principal investigators must demonstrate the ground-breaking nature, ambition and feasibility of their scientific proposal. To become eligible for Synergy Grants, principal investigators must also demonstrate that their group can successfully bring together the scientific elements necessary to address the scope and complexity of the proposed research question (ERC Scientific Council 2019).

In 2009 – and extended from 2015 – the ERC decided to introduce restrictions on applications in order to limit their number. Thus, researchers may only participate as principal investigators in one ERC grant at a time and may not apply for another ERC grant unless the existing project ends no more than two years after the call deadline. Furthermore, the ERC introduced a set of submissions restrictions on previously rejected applicants. (ERC Scientific Council 2019)

Evaluations and impact

The ERC draws, as mentioned, on international peer reviewers in their evaluation of proposals. Reviewers are selected based on their scientific merits and not e.g. because they represent Member States or specific organizations. Luukkonen (2012) investigated ERC's peer review processes and concluded that they had conservative elements which worked against the ERC's aim to promote frontier research. She stressed that peer review does not necessarily create obstacles to the support of novel research, particularly if novelty is an explicit evaluation criterion, but that the ability of the peer review process to support the ERC's goal was particularly challenged in the "grey zones", i.e. when proposals were deemed to be potentially novel but also involved risks that were difficult to assess within existing scientific paradigms.

Luukkonen (2012) also pointed to the significance of the observation that panel members sought to reach consensus, the outcome of which was sometimes determined by just one or two persons. She also emphasized that the ERC supports individuals but focusing mostly on their ideas, thus putting them in contrast to an instrument focused purely on supporting promising or outstanding individuals as seen in, for instance, the HHMI Investigator program (as described in case no. 3 in this background report).

Similar reflections were expressed during an interview (Matteo Razzanelli, Policy Adviser 2019), which confirmed that the ERC has in its internal discussions and analyses considered that peer review processes can potentially present biases against novel and interdisciplinary research. The ERC has addressed this risk in a variety of ways, and most notably by choosing to have a limited set of highly interdisciplinary panels, recruiting panel members with broad scientific expertise ('generalists') instead of just specialists, and by requiring reviewers to explicitly assess the proposed projects in terms of their ground-breaking nature, creativity and high risk/high gain profile.

In recent book, König (2016) highlighted the potential role of the ERC in supporting the growth layer of early career researchers with novel ideas, as the ERC offers promising young scientists a large grant at an early point in their academic career.

In the most recent evaluation of completed ERC projects (ERC 2019), 16% of the projects were deemed to have resulted in scientific breakthroughs, while an additional 59% were deemed to have made a major contribution to science. Moreover, close to two thirds of the projects were said to have opened up a promising new research agenda or possible paradigm shift. Finally, it is worth noting that two thirds of

the projects were characterized by reviewers as “high-risk/high-gain” proposals at the time of the grant decision.

Generally speaking, the ERC grants have been associated with highly novel science, including as seen e.g. in the latest Nobel Prize announcement on Physiology or Medicine. In addition, the ERC grant schemes can be seen as an instrument to fight conservatism at institutional level, by empowering early stage grantees to make hiring and spending decisions within institutions that would otherwise limit such decisions to very senior academic staff. These early stage researchers base their decisions on their own research agenda as outlined in the ERC project.

3. The HHMI Investigator Program – "funding people, not projects"

Box 3.1. The HHMI Investigator Program in brief

Targeted towards early-career and mid-career biomedical researchers, although each competition defines the breadth of scientific disciplines to be considered within biomedicine.

Funding for HHMI Investigators employed at research institutions with full salary compensation and possibility for other benefits for investigators and other eligible employees. Investigators may submit request for funding of major equipment. HHMI does not fund indirect costs at the host institution.

application submitted → first peer review of all applications → second peer review including brief research presentation by semifinalists before advisory panel

Grant period

Funding period (renewable, with no stated limit to the number of times renewal is possible)							Phase-out support upon non-renewal	
1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs	7 yrs	1 yr	2 yrs

The program delivers both high-impact articles at a much higher rate and more articles with few citations compared to control group, suggesting the possibility of a more explorative approach to research resulting in both "hit" and "flop" publications. Changes in the direction of investigators' research suggests the program prompts them to explore novel lines of inquiry. Results may however not be generalizable to the larger population of scientists eligible for grant funding and to other funding bodies as: 1) HHMI supports only highly accomplished scholars, which raises the question, whether researchers with more modest talent would drive their research equally far if provided with the same funding; 2) the positive effects of the program could be sensitive to the quality of peers at the investigators' institutions, which in the case of HHMI are limited to a number of eligible universities in the US; 3) the quality of feedback from high-level reviewers would be difficult to maintain should the program dramatically be scaled up 4) it may prove difficult for a public funding agency to assume the same degree of risk-taking with taxpayer funds as a private foundation like the HHMI.

About the funder

The Howard Hughes Medical Institute (HHMI) Investigator Program has funded researchers since the 1980s with extensive financial commitment and substantial impact on the research undertaken by the funding recipients. At the end of fiscal year 2018, the Institute had 20.4 USD billion in consolidated diversified net assets, making it one of the world's largest private supporters of basic biomedical research and science education. Close to two thirds of HHMI's 889 million USD expenses in 2018 went to funding for medical research.

The non-profit medical research organization plays a significant role in advancing biomedical research and science education in the United States. Created in 1953 by aviator and industrialist Howard R. Hughes, the HHMI was dedicated to basic research principally within the field of medical research and medical education. The institute was founded as a medical research organization, funded by the Hughes Aircraft Company until 1985, when the company was sold. This established the Institute's net worth, which in turn determined the amount that HHMI must spend each year on research (Howard Hughes Medical Institute 2019).

About the HHMI Investigator Program

The Institute employs investigators, which conduct their research in the laboratories of their host institutions, allowing for a cross-fertilization of ideas and people at research institutions across the US. Since the beginning, HHMI has focused on funding people rather than projects, as reflected for instance in the Institute's flagship program HHMI Investigators but also in other HHMI programs.

The HHMI Investigator Program provides investigators with ample possibilities for risk-taking in their work by providing long-term stability in funding and time allocated to research. Appointees become full-time employees of HHMI but remain physically located at their current research institution.

Investigators are presently appointed for an initial term of seven years, and the appointment may be renewed for additional seven-year-terms, each contingent on a successful scientific review – with no apparent limit on the number of renewals possible. Even if a scientific review is unsuccessful, the investigator will be provided with two additional years of phase-out support beyond the seven-year term (Howard Hughes Medical Institute 2018).

HHMI pays the full salary of the investigator and offers a benefits package to investigators and other eligible employees. In addition, investigators may submit requests for funding of major equipment. HHMI does not fund indirect costs at the host institution.

The HHMI Investigator Program is targeted at highly accomplished early and mid-career researchers, though career-stage considerations have varied over time. At present, investigators are required to hold a PhD with at least three but no more than 12 years of experience, providing them with enough time to establish themselves as independent from their postdoctoral or graduate adviser. They are also required to hold a long-term position, such as a tenured or tenure-track position, at one of over 200 research institutions in the US deemed eligible by the HHMI. Although investigators are technically employed by the HHMI, the appointment does not affect their faculty status at the research institution of their original employment. HHMI Investigators can move their appointment to another research institution only once during their tenure with HHMI. In addition to having obtained a long-term position, potential investigators need to have proven their ability to attract national peer-reviewed research grants with a duration of at least three years.

New investigators are appointed through a national open competition. Each competition defines the breadth of scientific disciplines to be considered. However, most competitions are open to all biomedical disciplines.

HHMI Investigators are required to devote at least 75% of their total professional effort to the direct conduct of research. They may spend up to 25% of their professional time on administrative duties, teaching, faculty service, and consulting.

Selection of HHMI Investigators

Applicants for the HHMI Investigator program are evaluated according to a number of attributes as listed in box 3. 3.2. These attributes are used both in the initial review and in reviews with a view to renewal.

Box 3.2. HHMI Investigator Attributes

"HHMI Investigators have a combination of the attributes listed below (…):

- They identify and pursue significant biological questions in a rigorous and deep manner.
- They drive their chosen research field into new areas of inquiry, being consistently at its forefront.
- They develop new tools and methods that enable creative experimental approaches to biological questions, bringing to bear concepts or techniques from other disciplines when necessary.
- They forge links between basic biology and medicine.
- They demonstrate great promise of future original and innovative contributions.
- They are active in service and training in their host institutions, and in the greater scientific community."

Source: Howard Hughes Medical Institute (2018)

Applicants apply directly through the periodic competitions. There is no nomination process, and no limit to the number of applications possible from a single institution. Applicants apply by submitting:

- A CV (three-page limit)
- Bibliography with peer-reviewed publications and preprint publications (eight-page limit)
- Description of major achievements (250-word overview)
- Abstract describing the biological questions, goals and approaches of the research program (300-word limit)
- Research program (3.000-word limit) summing up ongoing and planned research program, with up to one page of figures
- Five peer-reviewed publications of note reporting the most important scientific contributions, with an emphasis on the most recent five years.

The selection of investigators is made by the scientific leadership of the HHMI and is based on assessment by a panel of distinguished scientists, including members of HHMI advisory boards. This review process results in the selection of semifinalists. Further review includes a symposium attended by the HHMI scientific leadership and the final advisory panel, at which each semifinalist will make a brief presentation of their research.

The review process moreover provides candidates with rich feedback and high-quality advice on their projects, something which is further emphasized as a benefit by the HHMI Investigators that participate in annual science meetings during which they can interact with other HHMI Investigators. This gives them access to a deep level of critique, encouragement, ideas, and new potential collaborators (Azoulay, Zivin, and Manso 2011).

The HHMI review panels are generally very tolerant as to achievements in the short run. Thus, an evaluation of the program reveals that the first review of an investigator tends to be insensitive to achievements during the first appointment, whereas higher achievement significantly increases the likelihood of renewal at the end of the second term (Azoulay, Zivin, and Manso 2011).

Impact of the program

One of the main features of the program's focus on investing in people is that it allows its investigators the freedom to change the direction of their research. This effect was one of the key findings from an evaluation published in 2011 by Azoulay, Zivin, and Manso (2011).

Azoulay and his colleagues studied the careers of HHMI investigators, comparing them with recipients of R01 grants from the National Institutes of Health (NIH), whose programs are characterized by short review cycles, predefined deliverables (rather than in-depth feedback on performance), and renewal policies that are not tolerant of failure. They found that the HHMI Investigators produced high-impact articles at a much higher rate than similarly accomplished scientists funded by the NIH. They were however also more likely to "flop", i.e. publish more articles that failed to clear the citation bar of their least well-cited pre-appointment work. Further examination by Azoulay and colleagues thus indicated that the HHMI Investigators were not simply "rising stars" that were picked up and funded by HHMI, but that they appeared to place more risky scientific bets subsequent to their appointment as HHMI Investigators. The authors also found that HHMI Investigators' work was characterized by more novel keywords than controls, and cited by a more diverse set of journals (as compared to before their appointment and to the control group). Their findings, the researchers argued, suggest that the HHMI program leads to changes in the research of HHMI Investigators, inducing them to explore novel research paths.

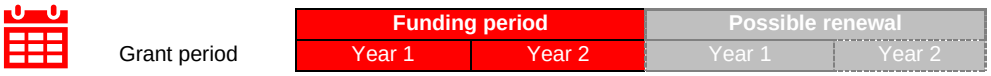
However, Azoulay and colleagues warned that it is unclear how easily, and at what cost, the program could be scaled up; they emphasized that their results might not generalize beyond the outstanding existing recipients of the HHMI Investigator grant to the broad population of scientists eligible for grant funding, and that the quality of the feedback provided by elite, recognized scientists would be likely to decline if a greater number of investigators were appointed and the costs of providing feedback grew accordingly. Finally, the authors pointed out that the nature of the HHMI as a private foundation provides degrees of freedom not readily available to public foundations, which for instance must often provide funding for a wider set of scientists and research projects.

4. The VILLUM Experiment – funding unorthodox, early-stage ideas

Box 4.1 The VILLUM Experiment Program in brief

VILLUM FONDEN is a private foundation based in Denmark. The VILLUM Experiment targets unorthodox ideas in the early phase which are difficult to find funding for elsewhere within the technical and natural sciences. The program primarily supports physical sciences and engineering, but also research in the life sciences[3]. All researchers can apply, but applicants must hold a doctoral degree or similar at the application deadline and must not already hold a grant from VILLUM FONDEN. The grant must be hosted by a Danish university or research institution.

Applicants can apply for 1-2 million DKK for up to two years to pursue high-risk, high-gain projects to explore the breakthrough potential of their idea. The funding can cover project-related costs such as salary, equipment, travel and operating expenses. The program covers up to 15% of indirect costs at the host institution. Grantees must be employed at Danish universities or research institutions.



The program started in 2017 and is still running. The program is still too young for its impact to have been reliably documented. However, VILLUM Experiment grantees differ from grantees from other programs at VILLUM FONDEN, e.g. regarding the grantees' career stage and merits; this suggests that the program provides support for other types of applicants than those supported via the foundation's other programs and traditional peer review process. A research project is underway at the Danish Centre for Studies in Research and Research Policy, Aarhus University, to evaluate the impact of the program; this evaluation is expected to be completed in 2024.

About the funder

VILLUM FONDEN was established in 1971 and is a part of the VELUX Foundations together with VELUX FONDEN. VILLUM FONDEN is a non-profit philanthropic foundation that supports technical and natural sciences research as well as environmental, social and cultural purposes in Denmark and abroad.

The assets of the VELUX Foundations amount to approximately 13.5 billion DKK, of which the tied-up assets amount to approx. 9.5 billion. It is the return on the tied-up assets as well as other income that

[3] VILLUM FONDEN does not support health or veterinary research, i.e. research focused on the health of humans and animals, including nutrition, medicine, biomedicine, pharmacology and research within diagnostics and methods for examination and treatment. VILLUM FONDEN does not support research which has its main root at university hospitals, or at health science faculties and departments (VILLUM Experiment Call 2019).

can be distributed for non-profit purposes. VILLUM FONDEN manages the legacy of the founder, VILLUM Kann Rasmussen, a Danish engineer and founder of V. Kann Rasmussen & Co, the later VELUX A/S. In 2018, VILLUM FONDEN awarded 625 million DKK in grants.

The VILLUM Experiment

The VILLUM Experiment is aimed at promoting high-risk, high-gain research. The program supports "*the ideas which have a limited chance of succeeding but hold great potential if they do*" (VILLUM Experiment Call 2019). It has funded researchers with unorthodox ideas within the technical and natural sciences since 2017. The program is still running in 2019 and currently on its third call. The call is announced once every year, in open competition.

The intention of the experiment is to offer an alternative to existing funding schemes which are characterized by "*exhaustive grant proposals, which go through a rigorous review process and are evaluated by the highest measure of excellence. This process might exclude a certain class of breakthrough ideas that are unripe, too risky and even naive at first glance*" (VILLUM Experiment Call 2019). The aim of VILLUM Experiment is to create opportunities to explore such potential breakthrough ideas with small funds and a minimum of requirements from the funder.

In 2018, the program funded 53 experiments with between 1 to 2 million DKK per grant, depending on the amount requested by the applicant. In total, the program has received approximately 1,300 applications across the three calls. 20% of the applicants were women, and applicants were generally between 30 and 50 years of age, with most applicants being between 35 and 40 years of age. The program has had success rates of 12% (2017), 13% (2018), and 11% (2019). The total budget for the program has grown from 50 million DKK in the first year to approx. 100 million DKK in 2019, which represents 16% of the foundation's total appropriations in that same year.

The program's focus on the original research idea is aimed, over time, at providing answers to the question of what comes out of focusing less on criteria such as merit and feasibility in the review process – criteria which generally carry heavy weight in decisions regarding the allocation of research funding.

The VILLUM Experiment supports risk-taking by providing grants based on a proposal for an unorthodox research idea. Criteria such as track record, CV and feasibility are not included as criteria in the review sheet used by reviewers when reviewing applicants. The program furthermore highlights the focus on risk-willing researchers in the call: "*We wish to support researchers who trust their ideas fully and who are committed to the risk of failing and learning*" (VILLUM Experiment Call 2019).

According to the VILLUM FONDEN website, *"The VILLUM Experiment is designed to support untested potential breakthrough ideas by providing grants suitable for an explorative phase. The application and evaluation processes underpin ideas in their early phase and aim to facilitate unconventional thinking."*

In an interview (with Anders Smith, Head of Program for the VILLUM Experiment and Thomas Bjørnholm the Research Director from VILLUM FONDEN, 2019), key personnel in VILLUM FONDEN highlighted how their focus on risk-taking is also reflected in their expectations regarding projects: "*We have not succeeded in our risk-taking ambitions with the program if every project is a success. There should be a certain number of supported projects that did not lead to what was hoped for.*"

The VILLUM Experiment provides grants of between 1-2 million DKK per grantee that cover project-related costs such as salary, equipment, travel, running expenses and up to 15% of indirect costs associated with the project. Grants are given for a 1 to 2-year-period depending on the amount the applicant is applying for to explore the potential of the idea. There is also a possibility of grant renewal, when the original grant has expired.

Applicants must live up to the following guidelines (VILLUM Experiment Call 2019):

- The topic of the research must be in line with VILLUM FONDEN's definition of technical, natural and life sciences.
- The applicant must hold a doctoral degree or similar at the application deadline.
- Researchers who already hold a grant from VILLUM FONDEN are not eligible to apply.
- The grant must be hosted by a Danish university or research institution. If required, the research or part of it can take place at universities and research institutions abroad.
- Researchers can only be main applicant on a single application under each call.

The intention is that applying for an Experiment grant should take a limited amount of time in order not to discourage researchers who are willing to take risks. Applicants are asked to elaborate on the originality, the potential impact and the appropriateness of the proposed research for the program in their application (see box 4.2).

Box 4.2. VILLUM Experiment application requirements

Applicants must submit a proposal of 10,000 characters in total (incl. spaces, headlines, references and figure captions) including:

- **Project title**
- **In a nutshell** (Key question, key result, key impact (preferably no more than 5-10 sentences written in layman terms.)
- **Research idea and context** (Starting point, open question, relevance, perspective.)
- **Proposed method of solution or concept** (Unique approach and, if applicable, novel hypothesis, non-standard methodology, etc.)
- **Major gains and obstacles** (What are the expected gains of the explorative phase? What are the possible obstacles? What do you define as criteria for success? What would be the next step if the idea turns out to be successful?)
- **Appropriateness** (Why is your research idea unlikely to be fit for the conventional research project programs?)
- **Probable objections** (Which objection(s) have you met or expect to meet from the reviewers? And how would you argue against it?)
- **Figure(s)** (If relevant, a maximum of two explanatory figures is allowed)
- **Separate budget, CV and letter of support from the host institution.**

Source: Proposal guidelines, VILLUM Experiment (2019)

In the evaluation of applications submitted under the VILLUM Experiment program, VILLUM FONDEN makes use of a scientific review panel instead of the usual committees, which are used for the assessment of applications in other programs under VILLUM FONDEN. The panel members are introduced to

the purpose of the program and their role at a one-hour meeting with the Head of Program or the Research Director.

The review process is “blinded”. The panel evaluates the proposed research idea without knowing the identities of the applicants, and the panel members do not know each other’s identity either. As VILLUM FONDEN write on their website: “*The applicant is anonymous to the assessors in order to sharpen the focus on the research idea and to allow the researchers to think freely in relation to their past merits. The assessors are asked to emphasize the ideas they perceive as real new breaks and which have a high risk factor in relation to success.”*

The scientific review panel for the VILLUM Experiment consists of 15 international researchers. The panel is organized in four sub-panels: (1) Earth and space (e.g. astronomy and geoscience); (2) Life science (e.g. functional biology and cellular biology); (3) Physical science and mathematics (e.g. chemistry and physics); and (4) IT and Engineering. Each sub-panel consists of three to four reviewers.

VILLUM FONDEN identifies and selects the researchers who serve on the panel. The panel members are recognized researchers with interdisciplinary knowledge and experience in assessing high-risk, high-gain research ideas, so each sub-panel has a broad coverage within the research area. All members of the panel are from abroad and must have an unbiased relation to the Danish research environments to avoid conflicts of interest.

Selection of VILLUM Experiment grantees

After applicants have submitted their proposal, the VILLUM FONDEN’s secretariat and the working group for technical and natural science pre-screen the proposals to secure they comply with the conditions of the program, e.g. to exclude applicants from other disciplines than the technical, natural and life sciences. All applicants are anonymous to the reviewers.

The proposals which pass the pre-screening are distributed among the four scientific review sub-panels, according to the proposal’s research area as defined by the applicant. As previously mentioned, each proposal is assessed individually by three members of the sub-panel without any interaction or coordination between the members to avoid that they influence each other in the assessment.

The panel members evaluate each proposal based on the originality of the idea, the potential impact, the appropriateness of the research for the program, and an overall score on a scale containing the categories ‘unsuitable’, ‘very good’, ‘excellent’ and ‘outstanding’. To *“increase diversity and respect the uniqueness of outliers”*, each panel member has a decisive vote which can be used only once (Review sheet, VILLUM Experiment 2019). The decisive vote is relevant in the case of a proposal which is found to be extraordinary and therefore should be prioritized. The decisive vote does not secure a grant, but the VILLUM FONDEN strives to grant applications which have received decisive votes along with the applications which have the best reviews in general.

Box 4.3. VILLUM Experiment evaluation criteria

VILLUM FONDEN's criteria for the assessment of applications are as follows:

- **Originality of the idea:** The idea shows unorthodox thinking and introduces a unique approach and, if applicable, a novel hypothesis, a non-standard methodology, etc.
- **Potential impact of the idea:** The idea holds the potential to answer a long-standing question in science, bring about a transformative understanding of a central topic, pave the way for a new research area or new method/technology or the like.
- **Appropriateness of the proposed research for this type of program:** The program aims to support unorthodox ideas in their explorative phase. The ideas must be of a nature which makes them unsuitable for conventional research project programs.

Source: +Review sheet, VILLUM Experiment (2019)

The proposals are ranked according to the panel members' evaluation. The panel members must provide a short statement for each of the top-ranked proposals.

CVs for the applicants are disclosed in the final screening to the VILLUM FONDEN's secretariat and the working group for technical and natural science. They check the researcher's level of expertise within the area of the proposed research project. The ranking of the proposals is maintained, but proposals that fail the screening test are disqualified. Grant applicants have not yet been rejected at this stage.

A final list of fundable proposals is recommended to the board of VILLUM FONDEN who make the decision on grants. Grant applicants have not yet been rejected at this stage.

Experiences with the program

The program is still too young for any impact to be have been reliably documented. However, VILLUM Experiment grantees differ from grantees from other programs at VILLUM FONDEN, e.g. with regards to grantees' career stage and merits, since the program supports a wide range of researchers from postdocs to professors. As explained in an interview (with Anders Smith, Head of Program for the VILLUM Experiment and Thomas Bjørnholm the Research Director from VILLUM FONDEN, 2019), "*We have a large span of age and experience among our grant recipients – from young researchers on their first postdoc to senior professors.*"

An external consultant collected experiences and insights of the grantees from 2017 and 2018 through workshops for VILLUM FONDEN. This effort indicated that the experienced burden of applying to the VILLUM Experiment program is seen as low compared to other programs. Moreover, several grantees from the 2018 call described that they expected, if projects proved successful, to develop new collaborations, become more interdisciplinary and to enter new fields. Some furthermore anticipated an initial drop in publication activity, because of the unconventional nature of their projects.

A research project is underway at the Danish Centre for Studies in Research and Research Policy, Aarhus University, to evaluate the impact of the program; this evaluation is expected to be completed in 2024.

5. The NSF SGER mechanism – an unbureaucratic approach to supporting high-risk projects

Box 5.1. The NSF SGER mechanism in brief

The National Science Foundation (NSF) operated the *Small Grant for Exploratory Research* (SGER) mechanism during the period 1990-2006. SGER grants were awarded to small-scale, exploratory, high-risk research in the fields of science, engineering, and education normally supported by the NSF. SGER proposals could be submitted to any ordinary programs under the NSF.

SGER awarded a maximum of 200,000 USD for a period of two years; however, most grants were for smaller amounts and/or for shorter durations.

Grant period

Maximum funding period	
Year 1	Year 2

An evaluation in 2013 concluded that SGER had been successful in supporting transformative research projects. It also noted that the budget for the SGER-mechanism had been underutilized through most of the years that SGER had existed for, indicating that program officers remained relatively risk-averse and preferred distributing funding to more conventional projects. SGER was terminated in 2006 and split into two new initiatives in 2007, including the Exploratory Grants for Early Research (EAGER), a slightly modified version of SGER, where researchers can apply for up to 300,000 USD over a period of up to two years.

About the funder

The National Science Foundation (NSF) is a public research funding body in the U.S., which funds research within all scientific disciplines. Evaluations and strategic documents from the NSF have repeatedly underlined the potential to strengthen support for transformative science. A 2007 report on transformative research at NSF (National Science Board 2007) highlighted that there was a general perception in the scientific community that the NSF was not very effective in funding transformative science, and that the lack of a clear, common definition of transformative research in NSF created internal confusion and made it more difficult to assess the actual performance of the foundation's efforts to promote and support transformative research. The 2007 report also pointed out that many potentially transformative ideas were never submitted to the NSF and that when they were, they often required additional time to develop the application, particularly when the ideas called for the establishment of new interdisciplinary collaborations. Finally, the report identified several conditions which were not conducive to transformative science, stating (ibid., p. 4) that *"Transformative research frequently does not fit comfortably within the scope of project-focused, innovative, step-by-step research or even major centers, nor does it tend to fare well wherever a review system is dominated by experts highly invested in current paradigms or during times of especially limited budgets that promote aversion to risk."*

About the SGER program

The NSF has established a series of initiatives to support transformative research and address ongoing concerns about the foundation's ability to promote the pursuit of novel, high-risk ideas. Current initiatives are described on the foundation's website. One of the most well-known of their initiatives was the now terminated NSF *Small Grants for Exploratory Research* (SGER) mechanism, a.k.a. 'sugar' grants.

SGER was established in 1989 in response to criticisms of conservatism in NSF grants and peer review mechanisms. It was based on an earlier program, *Expedited Awards for Novel Research* (EANR), initiated in 1987 by the Engineering Directorate (Wagner and Alexander 2013). SGER was not a distinct program, but rather an agency-wide mechanism applied to all NSF programs, allowing their program officers to allocate funding for promising high-risk projects that were unlikely to obtain grants in competition with ideas characterized by lower degrees of novelty and risk.

The mechanism was described at various stages of its lifetime on the NSF website, e.g. under Guide to Programs and Grant Proposal Guide, The size of the SGER grant varied during the lifetime of the mechanism (1990-2006), but the last grants had a size of up to 200,000 USD, to be awarded for a maximum period of up to two years, with no possibility of renewal. Actual grants were often of a smaller size and/or shorter duration than the maximum grant size and period allowed for (Wagner and Alexander 2013). Earlier maximum grant sizes possible under SGER were 50,000 and 100,000 USD, and the average grant size over the 16-year lifetime of the mechanism was approximately 54,000 USD (ibid.).

Funding for the SGER mechanism came out of the budget for each of the ordinary NSF programs, which could all allocate up to 5 pct. of their total annual budget to SGER-grants. Over the 16 years that the mechanism was in operation, just under 5,000 SGER-grants for a combined value (in 2013-prices) of 284 million USD were awarded.

Potential applicants were advised to contact a relevant program officer before submitting an application to ensure the relevance of their application. This has also been described as a reason for the considerably higher award rate on SGER proposals, as compared to other NSF mechanisms (Wagner and Alexander 2013). In addition, NSF staff were allowed to convert a regular proposal to a SGER grant, if they felt that the proposal had merit but was unlikely to fare well in a formal peer review process; however, this option appeared to have been rarely used, as NSF officers were more likely to suggest during initial conversations with researchers that high-risk ideas should be submitted directly as SGER proposals (ibid.).

The aim of the SGER-mechanism was to provide an easy and unbureaucratic means for the NSF to fund "high-risk/high-gain"-projects that were unsuitable for or unlikely to fare well within ordinary programs; at the same time, the flexible set-up and limited budget offered a relatively low-risk strategy for the NSF with which to support potentially transformative research. As such, the grants were also characterized by tolerance towards failed experiments and null results.

Applications were limited to 2-5-page proposals, supplemented with short CVs and no more than five publications or other research products. Proposals consisted primarily of a description of the proposed project and had to include clear statements as to why the proposed research should be considered particularly exploratory and high-risk, the nature and significance of its potential impact on the field, and why a SGER grant would be a suitable means of supporting the work. As examples of types of projects

that could apply for a SGER grant, the NSF mentioned preliminary work on untested and novel ideas; ventures into emerging research areas; application of new expertise and new approaches to "old" research topics; multi-disciplinary work, particularly crossing NSF program boundaries; research having a severe urgency with regard to availability of or access to data, facilities or specialized equipment; or efforts of similar character likely to catalyze rapid and innovative advances.

Applications were not submitted to peer review but exclusively to internal merit review undertaken by NSF program officers. This increased the speed with which grants were processed and avoided problems associated with conservative tendencies in peer review. Evaluation criteria were the novel elements of the proposed project, the level of risk, and its expected impact.

Evaluation, impact and recent history of the SGER mechanism

All divisions under NSF made use of the SGER grants, albeit to varying extents. Based on an evaluation of the SGER mechanism, Wagner & Alexander (2013) concluded that SGER had been successful in supporting transformative research projects, stating that the number of projects that indeed resulted in "truly transformative scientific advances" exceeded the expectations of the evaluators.

Among other things, the evaluation highlighted the benefits of having both the principal investigators behind proposed projects and the NSF program officers assess the level of risk and the transformative potential of the idea, underlining that this may be difficult for the driving principal investigators to assess on their own (ibid.). Moreover, Wagner & Alexander (2013, p. 188) found it *"(…) reasonable to conclude that the SGER mechanism encouraged PIs to propose research ideas that were 'riskier' than they might propose in a standard grant process. (…) In particular, those respondents who felt that their proposed research constituted a 'venture into emerging or potentially transformative research ideas' believed that their proposals were 'too high risk' to be submitted for a standard grant."*

The evaluation findings also led Wagner & Alexander (2013) to conclude that SGER had been effective in providing funding for researchers who belonged to under-represented groups, including female scientists, and in supporting mid-career principal investigators in changing their research focus or exploring new approaches to existing research interests, leading in several cases to transformative work.

Wagner & Alexander (2013) also noted that the budget for the SGER-mechanism had been underutilized through most of the 16 years that SGER had existed for at the time. For instance, a 2001 NSF evaluation of the SGER mechanism found that SGER accounted for about 0.6% of the agency's operating budget, i.e. far below the 5% of funds that could to be committed to SGER grants (ibid.). According to Wagner & Alexander (2013), this indicated that despite SGER's explicit emphasis on supporting transformative science, program officers remained relatively risk-averse and preferred distributing funding to more conventional projects.

SGER was terminated in 2006 and split into two new funding mechanisms in 2007. One of these mechanisms is focused on providing funding for projects aimed at mitigating or responding to critical events, which had become a focus area under SGER because of its flexibility and decision-making speed. In addition, the NSF established the *Exploratory Grants for Early Research* (EAGER), a slightly modified version of SGER, where researchers can apply for up to 300,000 USD over a period of up to two years. EAGER applications, like SGER applications, are submitted to internal review by program officers only.

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