

SUMMARY REPORT: EVALUATION OF THE HUMAN FRONTIER SCIENCE PROGRAM

Prepared for:
**The International Human Frontier Science Program
Secretariat**

Prepared by
**The ARA Consulting Group Inc.; and
Policy Research in Engineering, Science and Technology
(PREST), University of Manchester**

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1. Introduction

1.1 Program Description

1.1.1 Goals

The concept of the Human Frontier Science Program (HFSP) was proposed by then-Japanese Prime Minister Yasuhiro Nakasone at the Venice Economic Summit in June of 1987. In this proposal, Japan noted its desire to increase its contribution to international basic research. Following development of the concept by international committees representing the seven Economic Summit countries and the European Commission, an agreement was reached in July 1989 at an intergovernmental meeting in Berlin as to the goals and structure of the program. The main intent of the HFSP is to foster intercontinental collaboration in fundamental research on biological functions, through a program based on international peer review. In addition, there are a number of subsidiary goals, primarily to promote interdisciplinary research, to promote intercontinental research, and to involve younger researchers.

In order to ensure a timely start, Japan agreed to contribute significant funding to the HFSP during an initial three-year phase, with the remaining support coming from other partner countries termed the Management Supporting Parties (MSPs). The program's Secretariat was incorporated as a non-profit association in October 1989 in Strasbourg, France, and the first annual awards were made in March 1990. Current MSP members are Canada, France, Germany, Italy, Japan, Switzerland, the United Kingdom, the United States and the European Commission.

1.1.2 Program funding

The annual budget of the HFSP from fiscal 1990 through 1995 has varied from about \$31 million to \$42 million, with Japan contributing roughly 80%, Canada and the US providing about 10%, and the European countries giving about 10%. Exhibit 1 shows the contributions of the MSPs to date and Exhibit 2 shows the distribution of HFSP funding among the program components for a typical year, 1993/94.

Exhibit 1: MSP Contributions (including in-kind contributions) [million US \$]

	Japan	Canada	France	Germany	Italy	Switzerland	UK	USA	EU
FY1989	9.94		0.46		0.02				
FY1990	28.95	0.20	1.65	0.29	0.33				
FY1991	28.44		1.62	0.91	0.44	0.40		0.04	0.15
FY1992	29.57	0.40	1.32	0.77	0.19	0.40	0.51	0.04	0.18
FY1993	31.3	0.33	1.25	0.81	0.18	0.40	0.54	3.50	0.91
FY1994	34.01	0.54	1.56	0.99	0.18	0.40	0.59	3.50	1.11

Exhibit 2 Expenditure for Program Activities and Administration FY 1994 [million US \$]

Activity	Amount	(%)
Research grants	US \$ 27.45	64.26%
Long-term fellowships	US \$ 11.89	27.84%
Short-term fellowships	US \$ 0.18	0.41%
Workshops	US \$ 0.16	0.38%
Administration	US \$ 3.04	7.11%

1.1.3 Program operation

The HFSP supports basic research in two areas: brain functions; and biological functions through molecular level approaches. The primary mechanisms through which the HFSP carries out its mandate is through providing:

Research grants to international joint research teams working in one of the two main research themes. The principal investigator must be from one of the MSP countries. The number of grants awarded has slowly risen from 29 to 52 per year from 1990 to 1995, respectively, but since the number of applications has risen proportionally the success rate has remained roughly stable at about 12% to 13%. These grants have averaged about US\$225,000 for up to three years, although the mean

size has been slowly decreasing over time. Exhibit 3 shows the distribution of grants by country for 1995.

Exhibit 3 Total Research Grants by Country (1995)

Country	1995 Grants (US \$ thousands)	%
Canada	843	2.9%
France	1546	5.3%
Germany	2671	9.2%
Italy	843	2.9%
Japan	4358	15.0%
Switzerland	843	2.9%
United Kingdom	3374	11.6%
USA	8435	29.0%
CEC	3655	12.5%
Others	2531	8.7%
Total	29099	100.0%

Long-term fellowships for young scientists to allow them to stay for up to two years in top-flight international research laboratories, working with leading researchers, coming in contact with other disciplines, learning state-of-the-art laboratory techniques, and so forth. The fellow must either be from an MSP country or intend to work in a laboratory in one of the member countries. The fellowships are worth roughly US\$35,000 annually (the amounts vary slightly by country). The number awarded from 1990 to 1995 has risen from 72 to 160 per year, respectively. However, the number of applications has risen even faster; as a result the success rate has declined from 38% in 1990 to 23% in 1995. Exhibit 4 illustrates the distribution by nationality and host country of award holders for 1995. It may be seen that the USA is by far the most favoured destination for fellowship holders, accounting for 64% of the total, while Japan is the largest single source at 18% of the total.

Short-term fellowships for up to three months to be held at research institutions abroad, allowing scientists to become familiar with novel equipment or techniques, initiate new projects, make contacts, and so forth. Eligibility rules are the same as for long-term fellowships. In 1993/94, 28 were awarded for a success rate of about 23%.

Workshops for various purposes, especially those focusing on interdisciplinary topics. A new format has been introduced, with the purpose being to focus on specific and timely topics presented to a closed audience with an emphasis on discussion, but with published results being in a form accessible to non-specialists and distributed broadly. The first of the new format workshops was held in April 1995.

Exhibit 4: 1995 Long-term Fellowship awardees by Nationality and Host Country

Nationality	Host Country											TOT	%
	CAN	FRA	GER	ITA	JPN	UK	USA	CH	EU	Other			
CAN	0	1	2	0	0	5	9	0	1	1	19	12%	
FRA	0	0	1	0	0	3	6	1	0	0	11	7%	
GER	0	0	0	0	0	2	12	1	0	0	15	9%	
ITA	1	1	0	0	0	0	3	0	0	0	5	3%	
JPN	2	0	1	0	0	6	19	1	0	0	29	18%	
UK	0	0	0	0	0	0	15	0	0	2	17	11%	
USA	0	0	0	0	1	3	0	0	0	0	4	3%	
CH	1	0	0	0	0	0	4	0	0	0	5	3%	
EU	0	2	3	1	0	2	15	0	0	0	23	14%	
Other	1	4	5	0	0	1	19	2	0	0	32	20%	
TOT	5	8	12	1	1	22	102	5	1	3	160	100%	
%	3%	5%	8%	1%	1%	14%	64%	3%	1%	2%	100%		

1.1.4 Administration

Structurally, the HFSP consists of two main bodies. The Board of Trustees is responsible for overall policy, while the Council of Scientists is responsible for the scientific program. Both consist of two members from each of the MSP countries. In addition, there are four Review Committees, one each for research grants and fellowships in each of the two main research areas. These Review Committees, with the assistance of external reviewers who participate by post, carry out the peer reviews of applications. Finally, the Secretariat located in Strasbourg manages the administrative affairs of the HFSP.

1.1.5 The purpose of this study

The first HFSP pilot phase lasted from September 1989 to March 1992. The second phase began in April 1992. At that time it was announced that “a review of the effectiveness of the Program from the Scientific viewpoint will be carried out by the end of 1994, and a major review of all aspects of the Program will be conducted and reported by the end of March 1996 to the MSPs as a basis for considering the future of the Program”. The review of the scientific merit of HFSP research was done through the HFSP Review Symposium held in November of 1993, and the actions of the External Review of the Scientific Program in 1994 (these results are summarised in Section 7). The evaluation of other aspects of the HFSP program is the topic of this report. There were three main themes addressed:

- impacts of the program;
- effectiveness of the HFSP in meeting its goals; and
- review of program delivery mechanisms.

This Summary Report provides a brief description of the evaluation study and its findings. Far more detail is available in a Technical Appendix (e.g., tabular results of the survey findings, detailed case studies); contact the HFSP Secretariat for more information.

2. Evaluation Methodologies

The major study activities have been: review of documents associated with the program, interviews with HFSP Secretariat officials and staff, interviews with selected members of the Board of Trustees and Council of Scientists, interviews with a sample of members of the peer review committees (including some mail reviewers), telephone interviews with a sample of researchers, various mail/fax surveys detailed below, four case studies specifically directed at exploring the nature of collaboration, and a small bibliometric exercise. Preliminary results of the study were presented to a meeting of the Board of Trustees in December 1995 to obtain their comments and suggestions on interpretation. Finally, members of the Board provided some data on similar programs in their own countries.

Exhibit 5 shows the mail/fax surveys populations. With one exception, a census was done of potential respondents in HFSP's databases; for the unsuccessful grant applicants, only the "top rank" applicants (those who narrowly missed receiving a grant) were surveyed.

Exhibit 5: Survey Populations		
Survey groups	No. mailed/faxed out	No. returned (response rate)
Research grantees	525	315 (60%)
Long-term fellows	412	286 (69%)
Short-term fellows	110	46 (42%)
Supervisors of long-term fellows	108	64 (59%)
Unsuccessful research grant applicants	85	67 (79%)
Unsuccessful L-T fellowship applicants	261	117 (44%)

The number of personal or telephone interviews is shown in Exhibit 6.

Exhibit 6: Interview Respondents			
Group	No. of interviews		
	Canada, U.S.	Japan	Europe
Board of Trustees	6	2	7
Council of Scientists	5	2	5
Grantees	43	4	25
Long-term fellows	18	-	28
Unsuccessful grant applicants	13	5	10
Unsuccessful L-T fellowship applicants	10	-	17
Mail reviewers for grants	10	8	10
Members of the standing peer review committees for grants	10	7	8
Interviews for case studies of collaboration	15	1	3
Other	3	-	6

Roughly half of the researchers interviewed were established scientists and half were younger scientists. Brain and molecular areas were represented relatively equally. At various places in this report verbatim quotations from interviews are reproduced to give a clearer understanding of the messages being conveyed. The quotations selected, unless otherwise indicated, are representative of comments received.

3. The Grants Program

3.1 Program Value

Program uniqueness

Virtually all respondents of all types cited collaboration, especially at the international and intercontinental levels, as the major unique and successful feature of the program. High quality and unique research in important research areas were also mentioned, as was the support for younger scientists. Grant holders particularly were often quite enthusiastic in their remarks:

"It was really wonderful. It caused a synergism that would never have happened otherwise. It got people together who needed to be together."

"Very high! Tremendous! Very effective use of the money. One of the more effective values around."

"[The HFSP is] a really good idea. For a small amount of money, it injects a really good thing into the research — a genuine international community. It's harder and harder to do anything but pay lip service to international collaborations."

"[The HFSP has] done something that normal agencies don't do or see. It's made science far more international in information, ideas and philosophies. You don't see the immediate effects of it but now students just reach for the phone to seek out information, internationally. It's for the future."

Respondents said that international and intercontinental collaborations were virtually impossible to fund through their national agencies, most of which were reportedly reluctant to spend any money outside their own country. It was also remarked that interdisciplinary work was very difficult to support through national sources. Overall, scientists in Europe had slightly more funding options than those in the rest of the world, but their options were still very limited. It was noted that each partner in a team attempting international collaboration without HFSP usually has to acquire their own funding through national sources — this is obviously a hindrance.

"HFSP is unique in being an international program that does not carry the burden of politics to the same extent that other international programs do."

"In [my country], there are no publicly funded grants for postdoctoral fellows (only from private foundations) so HFSP fulfils a crucial need."

"Scientific refereeing is better [than in my country]."

Alternatives to the HFSP Grant

If unsuccessful applicants are able to carry out more or less the same research through other funding agencies, then the HFSP is not really as unique as reported. However, only 3% of the unsuccessful applicants reported that they were able to carry out exactly the same research and collaboration without the HFSP grant. (Those who did, carried it out with support from their own national funding agencies.) This figure is similar to the 8% of successful grantees who thought they could have done the same work without HFSP support. Although roughly half the unsuccessful applicants said they were able to do some of the intended research and collaboration without HFSP support, they were able to do significantly less collaboration (or none) and the scope of the research was diminished. The remaining half reported that they were not able to carry out any of the proposed research or collaboration at all. There were some small national differences, with Japanese scientists reporting the most alternatives, and North Americans the fewest.

Information supplied by the HFSP Trustees indicated that explicit national support for internationally collaboration was not available. However, some MSP representatives pointed out that national funding does not exclude international collaborative projects, though the latter have to compete with all other proposals. As an example of complementary support, the UK's Biotechnology and Biological Sciences Research Council operates a travel grant scheme to support discussions with prospective foreign collaborators for the HFSP and European programs.

Appropriateness of the research areas

Virtually all respondents felt the research fields defined by HFSP were quite appropriate and referred to them as important frontier areas. There is some feeling that the areas (especially molecular) are too broad, and there is some sentiment for either narrowing the fields somewhat, or for targeting specific research or researchers, perhaps through solicitations to submit proposals in specific fields.

Quality and importance of the HFSP research

Overwhelmingly, the quality of HFSP research was compared to the best research supported through national agencies. In fact, there was a noticeable increase in the proportion of world-class research reported done by the grant holders that is almost certainly due to the program.

The HFSP allows grant holders to work with leading researchers from other countries, obtain different perspectives on research problems through collaboration, and pursue really novel or creative research. (Few applied in order to buy state-of-the-art equipment, although this was a slightly more common reason for Japanese investigators.) The greatest value of doing intercontinental research is through the exposure to different traditions and methods of approaching problems. "Science isn't just science" was the view held by a number of somewhat surprised researchers, who added that the collaborations allowed a broader, less parochial approach. Many grantees commented that research today requires exposure to research and researchers world-wide, and especially requires hands-on experience. In a related issue, the chance to choose exactly the right people to collaborate with world-wide was mentioned by grantees and applicants alike.

"It seems to be of the same high quality as the research done for grants here. It is very, very good! So it's the same but unique."

“Excellent, corresponds to top echelon of the national funding programs.”

*“Research is changing. You need so **much** information to cover all areas of a field. It’s usually only the students who come to [our] labs, not the more experienced researchers. That’s not so in HFSP.”*

“I was introduced to people and technologies that I didn’t even know existed.”

“No one else in [my country] does this kind of work. Especially when it’s a narrow field with great specialization, you need to spread out to the world. The HFSP gives us the flexibility to get specialists.”

In interviews with European scientists, access to equipment and methodologies was also cited:

“Important equipment is usually developed first in the U.S., so it would be difficult to obtain funding from European or national sources to acquire this.”

“HFSP is particularly useful for the development of joint methodologies and technologies. In general, there is more emphasis on technological development in the U.S. and Japan, whereas the EU is better at methodological development. HFSP allows the two to be brought together.”

Findings from the bibliometric study

A limited bibliometric exercise was carried out, with the objective of assessing the impact of the HFSP upon the scientific literature and collaboration among HFSP grantees. The Secretariat was asked to identify a set of “core journals”, defined as those in which HFSP outputs might be expected to be published. Using a full list of HFSP grant recipients, the Science Citation Index (1994) was checked for journal articles published by grantees in the years 1992 and 1993. After elimination of general science journals and those with fewer than 30 articles per year by HFSP grantees, the remaining eight journals were analysed in detail. There were 1175 papers by grantees in the period, 7.2% of the total in the journals. Of that 1175, 163 papers (14%) acknowledged HFSP support. This disparity may arise either because the paper arose from work by the grantee which was funded from other sources or because the grantee did not include an acknowledgement to the HFSP.

A citation analysis was then performed. Since absolute numbers of citations are difficult to interpret, the analysis was based upon defining a particular journal in a particular year as a “case”, and then making comparisons between four groups: grantees’ papers acknowledging the HFSP, other grantees’ papers, a randomly selected cohort of papers from the same journals, and the journals’ impact factors (the mean number of citations per article in the journal for the year in question). The following findings emerged:

- in 61% of cases, papers acknowledging HFSP funding attracted higher numbers of citations than did other papers by grantees;
- in 85% of cases, papers acknowledging HFSP attracted higher numbers of citations than did the comparison cohorts;

- in 92% of cases, papers acknowledging HFSP attracted higher numbers of citations than the journal impact factor.

These results suggest that HFSP papers are having a substantial impact upon their fields and that grantees are producing work as good as, or better than their work supported by other sources.

Finally, an analysis of co-authorship indicated that only 7.7% of papers by grantees had two HFSP-supported researchers as authors, with a further 0.8% with three grantees as authors. Furthermore, there was little difference between the papers acknowledging HFSP support and other papers by grantees. It may be concluded that co-authored papers in these journals are uncommon and that HFSP funding does not appear to affect the propensity to produce co-authored papers.

Degree of risk

Respondents noted that it is difficult to obtain non-HFSP support for creative, innovative, riskier research. In the HFSP, by contrast, collaboration, interdisciplinarity, and access to top investigators tends to increase the scientist's ability to propose novel and risky research. It was mentioned that the mere process of collaboration tended to result in new, riskier directions being contemplated as a result of bringing together world experts from different fields and different traditions. Most grantees and unsuccessful applicants noted that the HFSP was better able to support such risky projects. However, also see the discussion below regarding the peer review process; some improvements may be possible.

*"You almost have to have done the research already in order to get funds [from national agencies]. If there is **any** question whether the work can be done, it will lower the rating [by the reviewers]."*

"[My national agency] only funds research with established methodologies which can be applied to important work. They are not much interested in multi-disciplinary research or multiple collaborations. If you have three of those factors combined, you definitely won't get funded [by this agency]."

Strategic Value of Being Involved

There was strong support from members of the Board of Trustees and the Council of Scientists for their countries being involved, and moderate support from the grant holders interviewed. The value for Board and Council members varied by country to some degree. Those from countries with "weaker" research cultures found the program provided a very useful window into world science, methodologies, and investigators, and it improved their profile in the world science community. Those from "stronger" research cultures found it useful to provide their scientists with important and different cultural views of the scientific process, ones which they would normally not pay much attention to. Other respondents suggested that the HFSP was encouraging their national funding agencies towards supporting more international research. Finally, some respondents commented that the HFSP was a crucial vehicle that allows scientists from impoverished countries (not MSP nations) access to world-class facilities and people through its fellowships and collaborative grants.

Information provided by members of the Board of Trustees indicated that the HFSP budget was in most cases very small by comparison with their national expenditure in the areas concerned. This

disparity was most dramatic in the USA where it was estimated that national expenditure on molecular research was \$4.3 billion and on brain research \$2.2 billion. However, for all members, calculations of the exact ratio of HFSP to national funding were not possible, as national funding data are not collected under the same headings as the HFSP areas.

Among the grant holders, more than half defined the strategic value of the HFSP to their country in terms of providing a broader, more global view of science for the member countries. They referred to the expanded level of expertise available through the HFSP, the ability to do the best research with the best people, and the opportunity to do more efficient research and avoid "reinventing the wheel" by duplicating work already done.

“It fosters international work in a way that nothing else does. Science doesn't recognise borders.”

“ [The strategic value of HFSP is] to put [my country] on the world stage . . . The collaboration is an important glue with the rest of the world.”

“For a small country like [mine] that does not have the critical mass to do world-class research in all areas, international collaboration is vital. HFSP provides an opportunity to do this.”

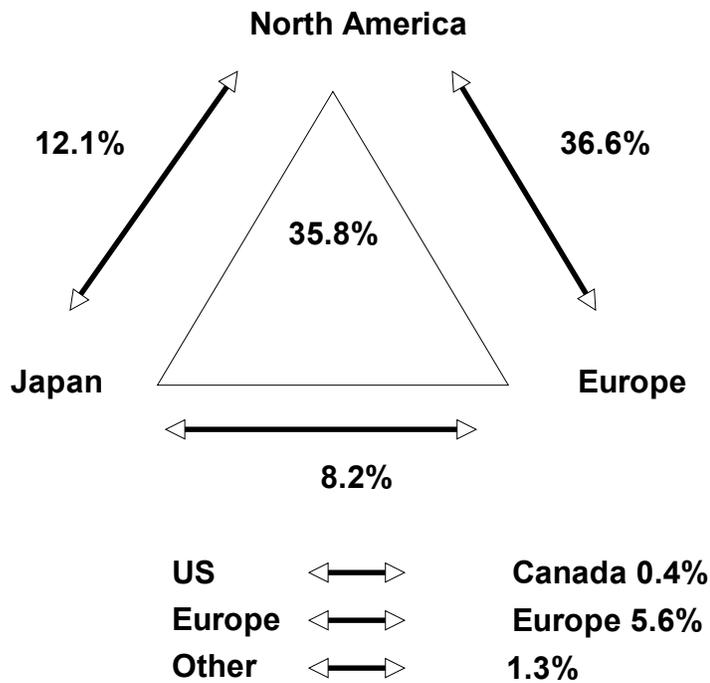
Japanese applicants also mentioned the value of HFSP's ability to cover salary payments which gave them scope to recruit scientists from abroad.

3.2 Nature of the collaboration

Intercontinentality

Exhibit 7: Intercontinentality

232 Research grant awards 1990-1995



The first issue to be addressed is that of intercontinentality. Exhibit 7 shows the patterns of collaboration between North America, Japan and Europe. This clearly demonstrates that at least 93 % of research grants are intercontinental and that 36% involve all three participating continents.

Survey and interview data

Also of interest is whether the HFSP teams are “marriages of convenience” or true collaborative arrangements. Several study components addressed this issue. First, the survey results indicated that about three-quarters of grantees said the project employed extensive interdisciplinarity (which implies collaboration), and the unsuccessful applicants’ data were similar with respect to their proposed projects. Further, almost all grantees found that the collaboration was either important or critical to achieving success in the project, and additionally that the HFSP project was fully or partially integrated with other research being done in their lab.

Most projects represented continuations at a more formal level of cooperation that had begun earlier among some members of the study team. This is not a surprising result, however, since in the normal scientific process one would expect formal collaborations to grow from earlier, tentative, informal cooperative efforts if they were successful. One might also expect collaboration to continue after the program's support for a particular project ended, and this was in fact the case: over 80% resulted in some further collaboration among the investigators after the HFSP funds terminated. Differences between successful and unsuccessful applications indicate that the HFSP selection committees are preferentially — and properly — supporting teams that have not been able to obtain funding from other national agencies.

The survey data also indicated that there is extensive interaction between all members of the study team, not just between the principal applicant and other team members. Differences in research patterns between successful and unsuccessful grant applicants also confirm that the grant has specifically allowed increased collaboration: successful applicants have increased their international collaboration by about 70% and their intercontinental collaboration by about 120%. The corresponding figures for unsuccessful applicants were increases of 20% and 19%, respectively. (Note that surveys were only sent to the “top ranked” unsuccessful applicants, who in most ways were very similar to the grantees.) Thus while both groups have done more collaboration over time, there is a much stronger increase for HFSP grant holders.

Other data showing the importance of the program for intercontinental collaboration come from the amount of funding grantees receive: in their first year since receiving their grant, researchers reported that their total research funding increased by 15% over the previous year. Further, the HFSP provided 25% of the average investigator's total funding, and was 94% of their total support for intercontinental collaboration.

The data indicate that the HFSP teams operated as true collaborative units with common goals, joint experiments, visits among labs, meetings, exchange of supplies, reagents, animal tissue or live animals (and even living patients in one case), as well as fairly frequent use of electronic means to communicate. The case studies confirmed that collaboration among team members was in fact extensive, extremely valuable, and usually successful. Many investigators were enthusiastic about benefits such as thinking in new and creative ways, being challenged by their colleagues, and being able to reconcile contradictory theories and experimental results. Although many means of interaction were used, scientists especially noted the value of face-to-face meetings.

Collaboration was often a learning process which took time to establish (two years was cited). Some respondents were at first unsure how to collaborate successfully. Because of this, some researchers would like to be able to renew their grants: sometimes the collaboration reportedly was just beginning to succeed when the grant ended. Some lessons that emerged from the interviews and case studies were that: (1) projects with small numbers of participants tended to be more effective; (2) it was more difficult to carry out effective collaboration when one component of the study, or the field of one investigator, was very different from the others; such differences also offer creative opportunities, however, and therefore require more attention to maximize their potential; (3) the more meetings, and the earlier, the better; (4) more and longer visits by postdocs would be beneficial; (5) careful definition of individual roles and expectations is important; (6) personality issues were important; and (7) it is often unrealistic to expect to conduct joint experiments across labs widely separated geographically; more realistic expectations are required.

Interdisciplinarity

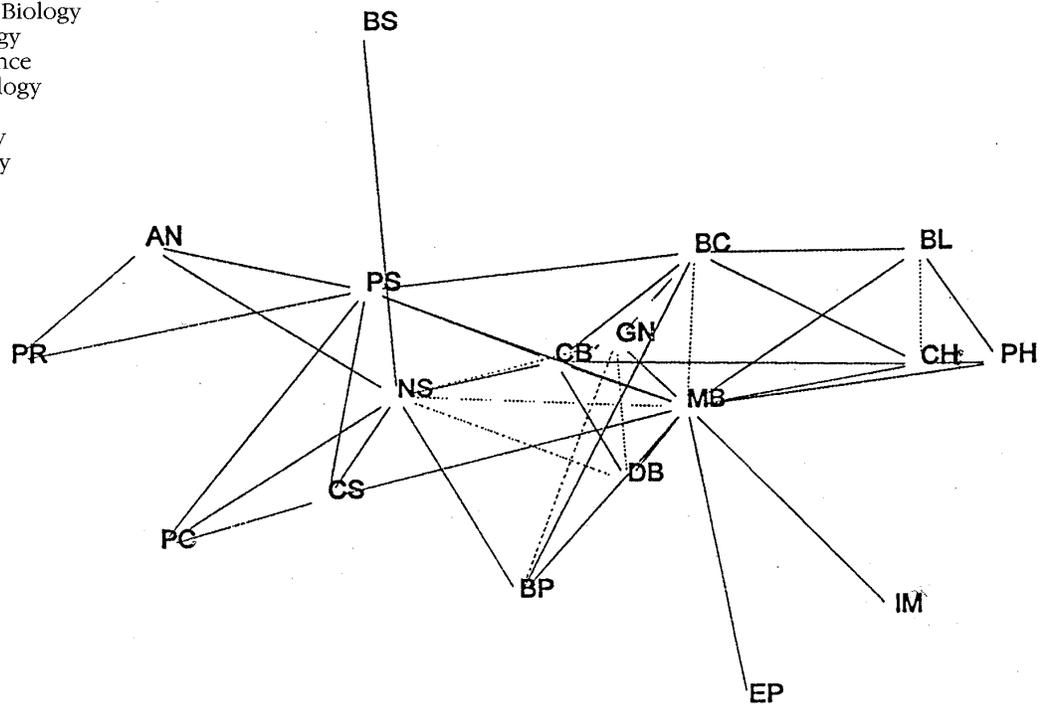
Interdisciplinarity in research is a key objective of the HFSP. Only 6% of grantees surveyed indicated that their projects fell solely within a single discipline. When asked which disciplines were drawn upon in their projects, 23 were cited, the five most frequent being molecular biology (98 times), neuroscience (67 times), genetics (62 times), biochemistry (56 times) and cell biology (48 times). There are also mentions of disciplines outside the life sciences, including chemistry (27 times), computer science (22 times) and physics (11 times). Exhibit 8 shows a network based upon the co-occurrence of disciplines in the responses. All the disciplines are connected but the exhibit shows only those with 13 or more co-occurrences. The location in the network is determined through multi-dimensional spacing. A strong central cluster consisting of molecular biology, genetics, cell biology and biochemistry emerges. The more traditional disciplines of biology, physics and chemistry cluster at the right hand side of the graph, while on the left there is a cluster of anatomy, pharmacology, physiology, computer science and psychology, with neuroscience as the central linkage for this group.

From this analysis, we conclude that the HFSP succeeds in its objective of promoting interdisciplinarity. While most of this is between neighbouring life science disciplines, there are also significant connections between radically different disciplines, mainly either in the cognitive sciences or in disciplines which involve the application of physical methods to molecular biology.

Exhibit 8: Network of Disciplines: Cut-off point 13 or more relationships

- AN Anatomy
- BS Behavioural Science
- BC Biochemistry
- BL Biology
- BP Biophysics
- CB Cell Biology
- CH Chemistry
- CS Computer Science
- CR Crystallography
- DB Developmental Biology
- EP Electrophysiology
- EM Embryology
- EN Enzimology
- GN Genatics
- IM Immunology
- LG Linguistics
- MB Molecular Biology
- M Morphology
- NS Neuroscience
- PR Pharmacology
- PH Physics
- PS Physiology
- PC Psychology

Network of Disciplines: Cut-off point 13 and more relationships



3.3 Support for Younger Researchers through the Grants Program

Many interview respondents said that support for younger scientists through both the grants and fellowships was a strong component of the HFSP. Support through the fellowships program is discussed in Section 4. Through the grants program, it occurs in two ways. First, the grantees themselves are relatively young: the mean and median ages are both about 43-44 years in the survey data. HFSP records indicate that the average age of Principal Investigators has been declining from 48.7 years in 1990 to 42.2 years in 1995. However, the average age of all award holders (including co-investigators) is little changed, rising from 43.6 years in 1992 to 45 years in 1995. A possible explanation is that applicants now perceive the priority given to younger researchers and thus are more likely to nominate a younger principal investigator. About a third of grantees were under 40 at the time of application. In these fields, investigators of this age are at a relatively early stage in their career.

Second, many grantees use a substantial proportion of their HFSP award to hire graduate or postdoctoral students; these are often the personnel who actually visit other labs in the collaborative research team. Interview respondents said the proportion of the award used for student and postdoc support was typically 40-80%.

The HFSP is not alone in providing support for less experienced researchers. Members of the Board of Trustees reported examples both of similar priority in standard grant programs and of dedicated schemes. One important difference was that in many cases, to avoid age (and associated gender) discrimination, eligibility for these schemes depended upon length of time since qualification or appointment rather than the age of the applicant.

Concern about the application of age criteria was expressed by unsuccessful applicants from Japan who commented that the average age of Japanese researchers tends to be high because they take longer to qualify than their North American or European counterparts.

There is reason to think the HFSP is equal to, or better than, national fellowship programs at supporting younger researchers in important work. The most important factors are through younger scientists making professional contacts and networking, improving their prestige and career, and having opportunities to work independently. About half the grantees interviewed thought the program provided unique benefits such as international collaboration and/or travel to other labs, exposure to broader and more global science; and hands-on experience in other labs. Networking was mentioned by several grant holders as especially important for younger scientists, particularly the chance to have this opportunity early in their careers.

“They [young scientists] end up with an unparalleled knowledge and experience of other countries, and establish a good network of contacts.”

“At this stage in their career [young scientists] wouldn't have any contact with such high level scientists if not for the HFSP grant.”

“HFSP is important for the “grooming” of the next generation of top flight scientists.”

Younger scientists also provided benefits to the labs where they worked, bringing in new ideas, expertise in new technologies, and high levels of energy. In addition these scientists brought to their labs the skills acquired by visiting international labs through the HFSP project, since the younger scientists were often the ones actually travelling between labs.

However, it should be noted that a reasonably high proportion of grantees interviewed had little information, and no opinions, about program support for younger researchers.

Overall, this indicates that, although the program has the potential to provide such support — and often actually does so in practice — at least in the grants component this impact may happen more by accident than through specific, well-thought-out HFSP goals and actions. As such, this impact is potentially vulnerable to changes in the structure of the grants program, such as reduced award size, changes in eligibility, and so on.

3.4 Program Visibility and Reputation

Respondents believed the program was being promoted to the right community of scientists. In addition, respondents overwhelmingly said the program had either a very good or excellent reputation in the research community and that it was considered competitive and highly prestigious to win a grant.

“Very good! Lots of positive comments. Very difficult competition. Seen as doing outstanding research —if others know about it.”

“Very successful and very popular. If alternatives exist, HFSP is usually chosen.”

However, it appears that the program is relatively unknown to the scientific community at large. There was some suggestion that the program was better known among scientists in the brain research area than in the (much larger) molecular area. Suggestions were made to advertise more frequently in scientific magazines and at conferences.

In addition, the HFSP publishes glossy brochures (which are not intended for a scientific audience). These were virtually unknown to about half of the grant holders interviewed. There is some indication that this was more true of co-investigators than of principal investigators. The remaining respondents thought the publications were good to very good, although a few people said they were somewhat biased towards information about Japan. In the future a scientific publication series will arise from the workshops (see Section 6).

3.5 The Peer Review Process

The nature of the peer review process is highly important because it determines the nature and quality of research and researchers supported. As a result, several evaluation components were directed towards it.

Opinions of grantees

The bulk of North American grant holders commented quite favourably on the peer review process during the interview program, adding that the people doing the reviews were well-chosen. The only major area of discord was the lack of feedback regarding unsuccessful applications. Europeans agreed with the latter point and a minority of them also expressed the view that the process was dominated by an exclusive group or by senior scientists who are averse to accepting high risk main applicants.

Roughly half the grantees thought the program struck a good balance between funding novel (but risky) research, and supporting more conservative (but less risky) work. Half also thought there was a good balance between funding the applications of established researchers and those of younger, unknown, scientists. However, very few thought the program funded too much risky research or too many younger investigators; where some shift in emphasis was preferred, it was almost always towards supporting somewhat more risky projects, and somewhat more unknown people.

Opinions of the peer reviewers on the Review Committees

Overall, the respondents believed the quality of reviews was good to very good, and all reviewers said that the structure of panels plus external reviewers was appropriate. Generally, reviewers thought the grant size was appropriate and almost every reviewer rated the review process as comparable in quality, fairness and timeliness to the peer reviews carried out in their national funding agencies. There are some concerns about the ability of the standing committees to properly review such a diversity of applications, but the mail review process is designed to alleviate this problem. There remain, though, some minor problems in this area due to the low return rate from mail reviewers as well as variability in the quality of the reviews.

It was suggested that it was of utmost importance for the HFSP database to be rigorously updated to achieve the greatest expertise possible. It was also suggested that an honorarium be offered to the mail reviewers as an incentive both to improve the priority given to the reviews and to increase the return rate.

Half of the peer reviewers thought there was a good balance in the research in terms of risk while the other half thought that the program funds too much conservative research. Opinion was also split among peer reviewers regarding who receives funds, but a majority believed the HFSP funds too much work by established researchers;

Committee members almost unanimously thought that female applicants and applicants from all countries were judged fairly. It was suggested from several sources that the committee sometimes made an extra attempt to fund under-represented countries or younger scientists setting up labs in more-poorly funded countries.

Reviewers generally thought that non-native English speakers were judged fairly, but several mentioned that a poor command of English is likely to have an impact upon the decision. Japanese reviewers felt that applicants from Third World countries were particularly handicapped in this respect but that it was not a problem for their compatriots.

Opinions of the mail reviewers

It is important to note that mail reviewers often did not have access to enough information about the decision making process of the panels or the results of its deliberations upon which to base an informed opinion. Overall, most mail reviewers believed that the Review Committee structure of panels plus external reviewers was appropriate, as was the dollar amount of the grant. Most reviewers also thought the review process was on par with their national funding agencies in terms of quality, fairness and timeliness.

Like the panels, the mail reviewers were also split between thinking that the program has a good balance in the research in terms of supporting risky versus conservative research, and thinking that the program funds too much conservative work. Several mail reviewers also thought that the HFSP funds somewhat too much work by established researchers.

Generally, the mail reviewers agreed with the panels that female applicants, applicants from all countries, and non-native English speakers were judged fairly.. A few reviewers commented that reviewers bent over backwards to not penalize non-native English speakers when the language of the applications was a bit awkward.

Feedback on rejected applications

About three-quarters of the unsuccessful applicants surveyed would like the Secretariat to provide applicants with verbatim, anonymous, comments from the reviewers, and most of the rest would prefer summaries of these comments. The successful grantees were more equally split: slightly more than half wished feedback via either method, while slightly fewer than half were satisfied with the present system.

In the interview program, although almost all the unsuccessful grant applicants thought the low success rate was a normal, if unfortunate, fact of life, the lack of feedback was seen as a serious problem by almost everyone. Respondents reported that they were unable to improve the application in any way since they did not know what the selection criteria were or what problems had been found with their proposal. Applicants frequently added that the lack of feedback shrouded the process and the program in “mystery” — as a result applicants often felt that the decisions were being made for political reasons rather than judgements of quality.

“It’s a big black box. It’s the only place you get no feedback, ever. I tried twice and still have no idea if I improved.”

“Without feedback I judged that the grants are not being judged on scientific principles.”

“The rumours are that it is being judged on a less than scientific basis.”

“No feedback is bad because it makes you suspicious that the decisions are political.”

There was strong support for providing feedback from mail reviewers. However, two of those interviewed cautioned that negative feedback might be discouraging to young researchers. From the perspective of the peer review Standing Committee members, responses to the issue of feedback were scattered. Some reviewers thought giving any feedback at all would just increase the number of

arguments that might take place in response to the feedback. Others thought that it was feasible and appropriate. One suggested that it was particularly important to let applicants know if their proposal had not succeeded purely on organisational grounds, for example lack of intercontinentality.

Discussions with Members of the Board of Trustees indicated that domestic programs in many of the MSPs provided feedback to applicants, either by passing on to applicants the verbatim comments of reviewers or by sending applicants a summary of the comments prepared by the secretariat. There was general recognition that such a provision represented best practice in peer review. The UK's Medical Research Council had introduced a feedback process without incurring additional personnel requirements.

Incorrect perceptions of the peer review process

About a third of the North American grantees interviewed volunteered that it was their impression (or the impression of their colleagues) that it was necessary to include a Japanese collaborator on the grant proposal in order to receive funding (no such views were expressed in Europe). All of our evidence confirms that this impression is incorrect. Almost without exception reviewers said there was absolutely no necessity to include a Japanese collaborator on the proposal in order to win a grant. This opinion was also strongly held by members of the Council of Scientists and Board of Trustees.

Many respondents (grantees and peer reviewers) believed that established scientists were far more likely to receive a grant than younger scientists.

“All principal applicants are well-known, over 50 years of age. A solution would be to put an age limit on applicants.”

Again the data cited in Section 3.3 refute this assertion.

We report these incorrect perceptions of the process only to stress that further dissemination of the activities of the Program and, we believe, the institution of feedback, would together further increase the reputation of the Program in the research community.

3.6 Administration

General administration

Survey respondents — grantees and applicants both — gave all aspects of the administration high marks. Virtually none of the grantees rated it as less than adequate and over 80% said overall administration was excellent. Only the size of the award was thought slightly low, and even then only by a small proportion of grantees. Unsuccessful applicants were almost as positive in their ratings, although a small number (about 20%) thought the decision process was too slow. In the interview program, overall comments from grantees about program administration were also extremely positive in almost all aspects. It was seen as an “almost invisible bureaucracy”, with the administrators viewed as helpful and co-operative.

"To the point, short application form, and the money transfer was very smooth. It was the least amount of hassle I ever dealt with. Very simple and straightforward, incredible really. Really fast. Very impressive."

"Orders of magnitude better than comparable {international} programs."

Structure of the peer review process: Opinions of the peer review Standing Committees

At present the peer review is a four-step process: there are reviews by the appropriate Standing Committee and the mail reviewers, followed by approval by the Council of Scientists and the Board of Trustees. Some of the reviewers thought that the review process was as streamlined as it could get. Reactions to suggestions for further streamlining were thoroughly scattered in nature, although most reviewers thought that it was necessary to maintain the current size of the standing committees. The role of the Board of Trustees in the peer review process was seen as necessary by some and unnecessary by others, and there was occasional concern that the respective roles of the Board and the Council of Scientists and peer review committees were somewhat unclear. Most respondents thought that the number of mail reviews should not be reduced, primarily because of the expertise problems discussed earlier.

3.7 Possible Changes to the Grants Program

Allocation of funds among HFSP programs and fields

There was no strong consensus regarding the allocation of funding among the grants, fellowships, and workshop components, although the majority of respondents prefer the current balance. Among those who thought the allocation should be adjusted, slightly more respondents suggested an increase to the fellowships program than suggested a decrease..

Most grant holders, when asked if they would prefer the Program to award fewer larger grants or more smaller ones, said that the current awards were about right in terms of number and size, and the current range of topics supported is correct — few would like to either narrow the range (to increase success rate or grant size) or widen it (to allow broader topics to be investigated). However, there has been a decline in the average size of grant (which in any case is reduced by about 30% from the amount requested). This attempt to spread the limited resources has led some interviewees in countries where labour costs are higher to complain that the level per investigator has fallen below that which is needed to employ a full-time post-doctoral researcher.

Funding from Management Supporting Party Countries

Virtually every respondent thought that member countries (including their own) should increase their support to the program if funding could be found, some saying that it was each country's obligation to contribute appropriately. A few suggested that the money might come from foundations, from industry, or from the diplomatic budget rather than from national science funding programs. European researchers also suggested a greater input of EU funding. For most countries, it was reported to us by those responsible that increasing HFSP funding would mean in some way decreasing funding for national agencies. Still, almost a third of the respondents thought that the

HFSP funding should be increased, even at some cost to the national funding sources (although some commented that it would depend on which specific agency's funds were cut). Almost no researchers thought that their country's HFSP support should be decreased. Many respondents (but especially those on the Board or Council) thought that significant increases to the HFSP budget were almost impossible in the present climate of national fiscal restraint for science.

Peer review process

More minor suggestions for changes to the process from the standing committee members, in addition to the major ones already mentioned, included a request to find techniques at the proposal stage to ensure that collaborations actually take place, such as including a collaboration "plan" in the application; using a shorter form for the applications; putting an upper age limit on who can receive awards (and generally increasing the emphasis on young researchers); and trying to find a way to review more of the applications in detail. In some cases it may be possible for mail reviewers to be present at the review committee meeting via a conference call, improving the quality and value of the feedback acquired from mail reviewers, although this is obviously limited by time differences around the world. Mail reviewers suggested that applicants should be given more detailed guidelines on what to emphasise, and also wished to have more information about the process they were involved in (for example, how many reviewers there were and who the committee members were).

Publicity and information dissemination

Increased publicity and improved information dissemination were the most frequently suggested changes to the current grants program. About a third of the researchers would like to see more information on what HFSP is doing, who is receiving awards and for what type of projects, and summaries of research results. The same proportion would like additional publicity for the program itself.

4. The Long-term Fellowships Program

4.1 Program Uniqueness

Fellows and applicants almost unanimously rated the HFSP as the most desirable fellowship. The large size of the award was the key factor in preferring the HFSP, but respondents also said that the program offered the ability to work in a lab outside their country, adding that the award allowed them to independently purchase research supplies and equipment. The opportunity to do research for two years instead of one, the chance to do work in their particular area, and the prestige of the HFSP were also mentioned as important factors.

However, about two-thirds of the successful fellows reported that they probably would have been able to work at their host lab even without the HFSP, generally via the research grants held by the supervisor, and sometimes through other fellowships that could have been held at the same lab. Although they did not receive HFSP support, 60% of the unsuccessful applicants are in fact currently at the host lab, doing exactly the same research applied for through HFSP, but supported either by the lab supervisor's grant or some other source of fellowship funding.

The fellows' supervisors agreed about the existence of alternative funding sources, although this varied substantially by country: 60-70% of supervisors in North America and the EC mentioned alternatives, but only 20% of those in Japan and 40% of those in other countries. In addition, most supervisors thought they could attract similar research fellows or associates to their lab without the HFSP support. Again, this varied by country: in Japan there was less certainty of finding alternate funding than in other nations. However, almost half the supervisors said that the fellow's research either could not be done at all or only with significant modifications without HFSP support.

These findings were supported by the HFSP's own survey, carried out in 1994, which found four other intercontinental fellowship programs in its field, together with one European program and 38 bilateral programs. (On the other hand, this survey also confirmed that the HFSP is the only program offering intercontinental research grants).

Overall, these results indicate that the HFSP fellowships are clearly an important source of postdoctoral support, providing some advantages over other fellowship schemes and being the preferred means of support for the fellows and unsuccessful applicants. However, unlike the research grants, this HFSP component is not unique.

4.2 Prior Relationship of the Fellows to the Host Laboratory

From a quarter to a third of the fellows and unsuccessful applicants were already working at the host lab in some capacity at the time of their award. The others knew the lab only by its research and reputation or had met the supervisor. About 85% of the fellows surveyed said their work was fully

or partially integrated with the work done by other researchers in their host lab, as well as being partially or extensively interdisciplinary.

4.3 Satisfaction with the Program and the Fellowship Position

Virtually all the respondents commented that this was an excellent program. In addition, almost all award holders were highly satisfied with their experience at their particular host laboratory.

“It is very good. I was really impressed. It’s unfortunate too many people can’t get it. It is very important for young scientists, as it gives the freedom to go where you like, especially internationally, and to do the work you want.”

“It was great. There was a lot of interaction and exposure to many different people with different expertise. The work was very interesting and exciting, and there were a lot of resources available.”

The survey respondents found that the most important benefits of their stay at the host lab were the chance to work with leading researchers, benefits to their personal prestige and career opportunities, and the opportunity to work as independent scientists. The sense of independence and confidence was also reflected in the fellows’ opportunity to travel, to buy supplies and equipment, and to learn specialized skills. The only aspect of their fellowship that was rated somewhat lower was training in project management skills. Finally, not only did fellows rate the training and other opportunities at their host lab quite highly; they rated these somewhat higher than the unsuccessful applicants did at their labs. In other words, the HFSP experience was not only good to excellent, it was better than the comparable experience of unsuccessful applicants.

4.4 Impact on Fellows’ Careers

About half of the fellows remained, or intend to remain, working in the host lab at the end of their fellowship, usually via support from their supervisor. Virtually all the others continued (or intended to continue) in research, mostly in an academic setting — about a quarter of the survey respondents whose fellowships had ended had found a tenured position in another institution, and 14% had an untenured post. About two-thirds were still working in the same research field, while another quarter were in closely-related areas. A very small number of the fellows have moved into industrial research

Most fellows thought that the award had (or would have) a very positive impact on their careers and ability to obtain their next position, as the award provided prestige, the opportunity to acquire expertise, and the opportunity to demonstrate their ability. For example, one mentioned that the skills learned in the host lab would make him the only person in his own country who had certain specialized skills in his line of investigation.

4.5 Benefits to the Host Lab

Not only fellows benefit from HFSP support. Almost all host labs reported that the additional skills brought in by the fellows, plus their addition to the size of the research team, were important benefits to the labs themselves. Many also reported that the reputation of the lab increased as a result.

Most supervisors thought very highly of their HFSP fellows: fully two-thirds of fellows were considered potential leaders in their field, and almost all the remainder were rated as good. Almost every supervisor would willingly supervise another fellow in the future. This high regard is also reflected in the fact that two-thirds of the supervisors (and 90% of those in Japan) kept the fellow on in some capacity after the award ran out. Only 3%, however, noted that the fellow found a tenured institute post. Where the fellow left the institute after the award, contact was almost always maintained, and about a quarter of the supervisors reported that they and their ex-fellow later entered into a formal collaborative project.

4.6 Program Administration

Overall, the administrative procedures were rated as very good or excellent, and the HFSP Secretariat staff were found helpful and efficient whenever there were problems or inquiries.

The guidebooks and the application forms were reported to be good or excellent, as were the size of the award and the payment procedures. Currency fluctuations were sometimes mentioned as a problem, though the generosity of the award tended to offset this. The timing of the applications was generally considered adequate but several fellows suggested that more frequent opportunities to apply would be better. A number of respondents thought that the decision-making process was too slow.

4.7 Suggested Changes to the Fellowships Program

Several fellows felt that the program should either be expanded or the fellowships extended to last longer. They also suggested that more information be made available about the program via a newsletter or perhaps by regional meetings of the fellows. This way the international collaborative aspect of the program could be further emphasised. More money for travel expenses was also suggested.

Unsuccessful applicants often felt that they should receive feedback. As for the grantees, the lack of feedback caused speculation as to the “real reasons” fellowships were not awarded..

5. The Short-term Fellowships Program

5.1 Study Findings

Most learned about the fellowship from journal advertisements or colleagues, and the fellows almost unanimously gave the application process a good or excellent rating.

The intent of these fellowships is to allow relatively young scientists the opportunity to visit other laboratories to learn new techniques, operate the latest equipment, and so forth. The survey results show that the fellows are indeed young: 35 years old on average, with a restricted range of from 25 to 47 years. Program records show that about half the fellows visit labs in the US and about a third go to EC nations. About half the fellows overall indicated that there are other fellowship schemes that would allow them equivalent opportunities, but there are far more options for those who wish to visit European labs than those in North America or Japan.

In general, the program was rated highly by the fellows in allowing them to achieve their goals: about 90% said it was good or excellent in this regard. Fellows found that the award was especially important in two areas: permitting them to work with the leading researchers in their field, and giving them experience in state-of-the-art research equipment. Fully 95% and 90% of fellows, respectively, gave their host lab a good or excellent rating on these topics. There were a number of other slightly smaller benefits as well, all of roughly equal importance. These included entering a new area of research, training in theory and methodology, making professional contacts and networking, learning the research culture in their host country, having the opportunity to work independently, and having positive impacts on their prestige and career. Only two items were rated as somewhat lower in importance. About half the fellows said that their host lab was only fair or poor at teaching them project management skills, and almost 40% said the same in terms of their opportunity to work in an interdisciplinary team. Note, however, that neither of these are objectives of the fellowships, nor may it be possible to provide such training (especially in project management) in the short time frame of the award.

The awards have also led to longer-term research collaborations between the fellows and their host lab or other researchers working with that lab. Following the termination of the award, over half the fellows entered into formal joint projects with scientists they met during their visit and about a quarter have informal collaboration. All the remainder have either maintained contact with their hosts or plan to collaborate in the future.

6. The Workshops

As noted in the introduction to this report, there has been a change in the format of the workshops. The first of these, which are all held in Strasbourg, took place in April 1995 and was on the subject of “Coincidence Detection in the Nervous System”. It is too soon to assess the changed format but feedback from participants on this occasion indicated that it brought together a range of people of very high quality:

“The top people in the field - excellent!”

The interactive discussion format was appreciated but it was pointed out that this meant that the production of a book afterwards was key to success. The use of a post-doctoral researcher to produce the book was considered by one interviewee to be a very effective aspect because it avoided established academics hi-jacking the discussion to their own ends.

Production of the book, which is intended for wide dissemination and to be usable for teaching, has been slower than desired. As this was the first iteration, organisational improvements can reasonably be expected in the future.

7. Results of the External Review Panel

The HFSP was reviewed by an expert External Review Panel (comprised of six distinguished scientists) in November 1993 at the request of the Board of Trustees¹. Members of the Panel examined over 100 approved grant applications and over 40 which had been rejected. Most of the results of this investigation were similar to those of this evaluation. For instance, the panel was impressed by the quality of the grant applications and subsequent research carried out. All of the questions asked were considered important, none trivial and many concerned key problems in biology. They noted the usefulness of collaborative investigation in the sample projects. Further, most grantees reported that the HFSP award was essential in carrying out their proposed research, supervisors expected the fellows to become leaders in their field, and the fellows had a positive impact on the host labs. The panel also commented that the general balance of topics addressed was appropriate. The Program's support for a broad spectrum of basic, long term research was supported, though the Panel felt that some topics, including molecular immunology, deserved more support.

The panel expressed concern about a few points as well. For instance, they worried that few research fellows chose to work in Japan as opposed to the US. They also suggested that the overall balance of grant projects supported might be somewhat too conservative, showing too much favour for established researchers and not enough for a healthy degree of risk, and there was some suggestion that direct or implicit support to younger researchers could be improved. Again, these findings are not dissimilar to our own.

¹ *Report of the External Review Panel on the Human Frontier Science Program*, HFSP unpublished document, April 1995.

8. Conclusions and Recommendations

8.1 Overall Conclusions

The general tenor of these findings is quite clear: the HFSP is an excellent and valuable program. Some aspects of the HFSP are unique among science support programs and it has a variety of components that succeed in fostering important research that is international, intercontinental, and unusually outstanding in character and quality. In addition, it provides significant support for interdisciplinary work, and it preferentially supports younger scientists. These impacts are not incidental, but are built into the goals and mechanisms of the program, particularly through its extensive peer review process and its focus on intercontinental collaboration. Finally, its administrative structures do not consume much of the budget and are effective enough to be considered as a possible model for other similar programs (we know of one other program currently reorganizing itself into a similar shape). The detailed discussions below — including those regarding possible improvements — should be read in this light.

8.2 HFSP Program Uniqueness

From all evidence, it is clear that the HFSP grants program has a distinct “market niche” among research funding agencies. In particular, the type of international, intercontinental, investigation supported by the program is very difficult to fund through most granting agencies, especially in North America and Japan, and is even actively discouraged by many national programs. Even in features where the program is not unique (e.g., in encouraging multidisciplinary work), the combination of features is singular. For Europeans, collaboration within the continent is now a regular part of the research landscape but collaboration at a project level with the U.S. and still more with Japan is rare.

The situation is different for the long-term fellowships program. Although the HFSP fellowships are different — and somewhat better — in many ways compared to similar national awards, they are not so different as to be unique, and it appears that there are a variety of other sources of funding that could support the same positions. This is not to say that the fellowships are not valuable — as they provide excellent benefits to the award holders — just that they do not stand out as strongly as the grants.

The short-term fellowships are again not unique, but only about half the fellows overall have access to similar support, and for those in North America and Japan there are few alternatives.

8.3 Value Added by the HFSP Program

It is not helpful for a program to be unique if it provides no benefits. In the case of the HFSP, however, the unique features of the grants program allows it to foster research that is at least equivalent to the top rank supported by national programs. Moreover, there is good reason to think that the best of the HFSP research may have strengths that are difficult to find in

nationally-funded research: e.g., collaboration between the best minds in a field, creative interdisciplinary proposals that incorporate investigators and methods not usually able to be brought together, opportunities for travel and interaction internationally by younger scientists, exposure to different ways of thinking about science and science culture, and influence on national agencies (and individuals) to “think globally”. Overall, the program provides a significant opportunity to increase the ability of individual investigators and teams to carry out world-class research.

The long-term fellowships program also provides excellent benefits to the award holders. Fellows obtain significant opportunities to work with leading researchers, become independent, and improve their career chances. Further, these benefits appear slightly greater than those provided through other means of support at similar labs. There is reason to suspect that these fellowships are among the best available — certainly they are the ones most preferred by recipients and unsuccessful applicants. The fellows themselves are usually leaders in their field and frequently go on to subsequent positions at their host lab, although at least 40% obtain their next position in their native country.

The short-term fellowships are working exactly as intended: they provide younger scientists with excellent opportunities to learn through exposure to the investigators and techniques at other world-class laboratories. Although there are some opportunities to obtain similar awards from other European programs, there are few alternatives in North America or Japan. There is, perhaps, some room for improvement at the host labs in providing interdisciplinary learning opportunities, but whether this is feasible in the short time frame of the fellowships is unknown.

8.4 Support to Younger Scientists

The results on this topic, while positive, are slightly mixed. On the positive side, the fellowships (long-term and short-term) and grants programs provide such support through direct involvement of younger investigators in significant research efforts, and through significant roles in that research for the young scientists. This has benefits for both the scientists (e.g., better career opportunities) and the participating labs (e.g., exposure to new techniques).

On the negative side, some of these impacts seem more accidental than planned in the grants program in terms of using the grants to support younger members of the team, and do not appear to be explicitly planned for in the minds of many grant recipients. In addition, there is some feeling that grants are awarded too often to established investigators instead of younger ones. Finally, the long-term fellowships program — although an excellent one — is only slightly better than those of other agencies in terms of the level of funding support and the quality of the experience offered.

8.5 Peer Review Process

The program has a very strong peer review process. In fact, in many ways it combines the most rigorous features of other systems, with only the consequential drawbacks of time and cost. Nonetheless, it is an admired feature of the Program and should certainly be maintained. There is a small degree of dissatisfaction among many participants with the balance of risky versus conservative proposals funded, and with the support to established

versus new researchers, but overall this concern is not vehement and is similar in extent to that often voiced about national programs. (And the HFSP is reportedly better than most on this score.) Nevertheless, the HFSP may wish to more fully distinguish itself on these matters compared to other programs.

All evidence suggests that applications are evaluated fairly with respect to all relevant criteria. In particular, there is no evidence for a bias towards supporting applications with Japanese investigators. However, the community does not always believe this, with the lack of feedback regarding unsuccessful applications allowing occasional rumours of political interference to surface.

8.6 Program Administration

There is great satisfaction with the simplicity, openness, and flexibility of the HFSP administration, as well as with the helpfulness of the Secretariat. Although some very minor problems have surfaced with respect to the appropriate roles of the Council of Scientists and the Board of Trustees, there is no consensus as to exactly what the problems are or what to do about them. At any rate, these do not usually — if ever — appear to affect the efficient functioning of the grants and fellowship programs (although they may cause the members of these committees some occasional problems).

8.7 Recommendations

Overall the program is highly successful and adds significant value to existing national research granting programs. Our suggestions below must be regarded in this light. We should also mention that many of the recommendations found below have been discussed at length by the Council of Scientists, the Board of Trustees, and the Secretariat during and prior to this study. Most have both pros and cons associated with them.

1. **Continued or increased support is deserved by the grants, long-term fellowships, and short-term fellowship programs.** The grants program is the most distinctive feature of the HFSP and is of demonstrable value. Although the two fellowships programs are not unique or absolutely essential, they are both excellent programs, provide significant benefits, and are valuable in their own right. In addition, they specifically and unequivocally concentrate on HFSP's stated goal of supporting young researchers. Evidence of underfunding comes from the high ratio of applications to successful awards and most strikingly from the inability of the HFSP to fund renewals, a most unusual predicament.
2. **Feedback should be provided to unsuccessful grant applicants.** This has scientific value to applicants, and (perhaps more importantly) should eliminate the mild suspicion that some grants may be awarded on a political basis. Other agencies have found that providing feedback does not always increase the agency's workload much, if at all.
3. **More emphasis should be given in the grants program to support for younger researchers.** There does not appear to be as much emphasis on explicit mechanisms to support younger researchers in the grants program as is appropriate given the HFSP's goals. Some further ways of encouraging such support in this program should be found, particularly for scientists who are neither principal nor co-applicants. However, the

definition of young researchers should be given further consideration in view of its inconsistency with practice in several MSPs. In particular, defining the limits in terms of age rather than experience or time in post, though simpler to administer, is discriminatory. A change of this type would also avoid possible bias against candidates from countries where it takes longer to be appointed to a position from which an application can be made.

4. **There could be more effort put into promotion and information dissemination to program participants.** For example, there could be expanded coverage within an internal newsletter (e.g., more reporting on “who, what, where”; brief summaries of research results). These need not be glossy or formal. Some additional means of communicating to the fellows could also be considered. For the wider scientific community, there are obviously opportunities for much broader promotion, but the value is uncertain — it would not be helpful, for instance, to increase the number of grant or fellowship applications even further. The current glossy publication should continue to be specifically targeted to policy makers.
5. **The Program should redouble its efforts to ensure that all publications arising wholly or in part from its support give it full acknowledgement.** The best possible source of publicity among the scientific community is for high quality papers to acknowledge support from the HFSP.
6. **Lessons learned regarding effective collaboration could be collected and distributed to new grant recipients.** (Some tentative lessons are found in Section 3.2. Some of these also apply to the review of applications in terms of likely success at collaboration.)
7. **The HFSP should reconsider its attitude to extension of grants.** The evidence strongly suggests that a collaboration takes some two years to become fully effective. In some cases there may therefore be a higher return from continuing a project than from starting a new one. Reviewers could judge the renewals on their merits in the usual way.
8. **The HFSP could be more focused within its existing scope.** One means of addressing the problem of over-subscription is to focus the program more. While there is little support for narrowing the scientific scope of the program, some thought could be given to whether there are areas within the existing scope which are inherently more likely to benefit from intercontinental collaboration and to indicate these as priorities.
9. **The HFSP model could be used in other areas.** The apparent success of the HFSP model suggests that its administrative and peer review mechanism could be used as a model for other scientific collaborations.