Evaluating Basic Science Investments: Toward a More Robust Practice

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Our understanding of the world—even our well-being—is shaped by advances in basic science knowledge. Philanthropic organizations play a crucial role in supporting the research that leads to such advances. For example, they support scientists, build organizations' research capacity and help train new generations of scientists. Philanthropies making such investments in basic or discovery science share a common goal—to catalyze advances in knowledge that improve our lives by enhancing our understanding of ourselves, our world and our universe. They also share a common challenge: establishing that their investments in basic science indeed contribute to advancing knowledge. This brief summarizes learning from early efforts by a working group of philanthropies and other organizations that are tackling this challenge together.

CONNECTING PROGRAM STRATEGY AND EVALUATION OBJECTIVES

The knowledge gained from basic science research has enabled transformative developments for society, such as research in solid state physics that led to the first transistor decades before the "IT revolution." New devices, methods and processes that result from applied science today are often made possible by much earlier breakthroughs in basic science. Private foundations, government agencies and other funders support basic research to help catalyze advances in scientific knowledge.

Generally speaking, private funders approach their investments in basic science just as they might approach any other program area—by devising and implementing a strategy about where, when and how they will seek to have an impact. Funders may promote a specific branch of science by supporting research led by accomplished scientists or by endowing a research center at a major university. Others may invest in up-and-coming generations of scientists by supporting graduate students, post-doctoral fellows or other early-career researchers. Some may seek to spur progress by awarding prizes for achievements in basic science.

Whatever strategies they pursue, most funders eventually want to understand whether their investments are reaping their intended results and are impactful. Did recipients of their funding create new knowledge? Did the funding contribute to an accomplishment that might not have happened otherwise? If not, would a modified strategy produce better results? One funder calls this a matter of "knowing when to get out and when to change course."

CHALLENGES OF EVALUATING BASIC SCIENCE INVESTMENTS

Assessing the impact of basic science funding is more complex than measuring the impact of applied science research or direct service interventions common in the health and human service arenas.

Even funding organizations that regularly monitor, evaluate and learn from investments in other program areas may struggle to understand the outcomes and impacts that result from their investments in basic science.

There are several reasons for this:

- Most impacts become evident many years after a typical grant period.
- Basic science does not follow a linear path and is not pursued as a means to a specified end.
- Many scientists, projects and institutions, working together or independently, contribute incrementally to progress.
- These scientists, projects and institutions rely on many sources of financial support.

These factors make it difficult to attribute advances in basic science to any one funding source.

Photo courtesy of Bob Paz, chip that contains optofluidmicroscope

ENVISIONING A BETTER EVALUATION PRACTICE

A community of funders of basic science is working toward a more robust approach to monitoring, evaluating and learning from their investments. Most of them are members of the Science Philanthropy Alliance.

These funders currently use various monitoring and evaluation methods to meet the information needs of program staff and organizational leadership. Some follow grantee progress through routine reporting; some measure outputs such as publications and citations; and at least one compares outcomes between the scientists it funds and those the organization declines to fund. While current evaluation approaches may vary, the funders in this community all share a desire to strengthen evaluation practices to improve basic science philanthropy.

The group met twice in 2016 to share knowledge, challenges and opportunities in assessing the impact of basic science funding. In fall 2016, the Gordon and Betty Moore Foundation invited Mathematica Policy Research to help members of the group explore issues they faced in assessing their portfolios and consider ways in which existing monitoring and evaluation methods could be relevant to the evaluation of basic science funding. This brief summarizes insights shared during the one-day workshop. Insights are drawn from plenary and small-group breakout sessions throughout the day.

Most impacts of basic science investments become evident after many years, not during a typical grant period.

INSIGHTS FROM THE WORKSHOP

Developing an impactful funding strategy

Although funding strategies were not a focus of the workshop, participants described several elements of their strategies that they reflect on when designing an evaluation approach. These include:

- **The unit of investment.** Participants described different funding approaches to support research in basic science, which include supporting individuals at different stages of their careers, research projects or institutions (such as universities or laboratories). The majority of participants also provide post-doctoral fellowships, while several offer graduate fellowships and prizes. A couple include undergraduate scholarships and research fellowships in their portfolios. Because the unit of investment becomes the unit of analysis in evaluation, funders must think through what success would look like for an early- versus a late-career scientist, for example.
- **The funder's appetite for risk.** Supporting research that is "too risky for other funders" emerged as a niche for philanthropies attempting to fill gaps "that government and the market won't take care of." At the same time, some participants acknowledged a tendency to succumb to the "Matthew Effect" by which support amasses to a limited number of well-known, successful scientists to the exclusion of new, promising scientists. When it comes to evaluation, funders who take risk must be willing to encounter failure. Funders who avert risk by supporting renowned scientists would expect to avoid failure and must be willing to accept that they may miss opportunities.
- **Whether to integrate financial and nonfinancial supports.** Some funders recognized that "just giving out money may not be enough." They stress the strategy of providing nonfinancial support to create a community of practice, to influence the quality of education or to enhance the experiences of individuals. As one funder said, "The longer I'm in philanthropy, I realize that it's not the number of grants or direct outputs, but the relationships and networks and convenings that are often groundbreaking. Two of our best grants have been for workshops, which spurred new collaborations and strengthened networks."

Organizations participating in the fall 2016 workshop

- Alfred P. Sloan Foundation
- Dalio Foundation
- Gordon and Betty Moore Foundation
- Heising-Simons Foundation
- Howard Hughes Medical Institute
- John Templeton Foundation
- Kavli Foundation
- Lasker Foundation
- Lyda Hill Foundation
- Research Corporation for Science Advancement
- Science Philanthropy Alliance
- Simons Foundation
- Wellcome Trust

Expanding on this theme at a higher level, others spoke of influencing the "environment" in which science happens through convenings, advocacy, policy development and capacity building. One example discussed was fostering "an open access policy" for research and/or data. Evaluating a portfolio that includes both monetary and non-monetary support can be challenging. When planning evaluations, funders who seek different types of impacts through complementary strategies also require complementary (mixed) evaluation methods.

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Fundamental challenges of assessing investments in basic science

Any evaluation effort—in any field—will face challenges. Group discussions suggest that, in the field of basic science investments, there are four fundamental challenges:

1. **Developing assessments when expected outcomes are not well-defined a priori**

   Participants asked, "What does success look like in basic science?" They also commented on the difficulty of setting up a measurement framework prospectively for something that cannot be precisely defined when a funding program is established or a grant is made.

   For some, the solution is to measure observable activities and outputs. However, one funder exhorted the group to avoid this practice: "Rather than measuring everything, first talk about what success looks like and [then] find indicators of success."

2. **Adjusting to the reality of research paths that are nonlinear and complex—both for researchers and ideas**

   Funders agree that knowledge is cumulative. It is driven by research that evolves incrementally and with contributions from many scientists through multiple funding sources and benefitting from each other's work in expected and unexpected ways. According to one funder, "Once you gain the understanding of the complexity, then you can look at your strategy more closely and realize you can't assume that just because you're funding something it will unfold as expected."

3. **Assessing contribution versus attribution in basic science investments**

   All funders would like to establish that their investments had an impact—that is, that the potentially groundbreaking results of the research funded or the collaborations supported can be attributed to their support. One funder noted that although it is sometimes not possible to "see the impact that can directly be attributed to you... seeing your contribution may [still] be useful." The need for this compromise results, in part, from unique challenges in assessing investments in basic science—such as the multiple funders and researchers that often contribute to making advances possible (see "Challenges" on page 1). Thus, it may be less feasible for funders to pursue evaluations that would confidently assess cause and effect.

   Nonetheless, some funders do collect information on a comparison group (those not funded) to support causal inferences, though they also acknowledge difficulties in doing so. For example, some funders follow scientists who meet or nearly meet funding criteria to approximate a counterfactual. Others follow unfunded scientists to verify the efficacy of their selection processes—that is, to ensure that those processes help them recognize potential in applicants.

4. **Adequately tailoring measurement given the breadth of foundation portfolios of investments in basic science**

   Funders' investments are not exclusively in research—and sometimes not in research at all—even though they all share the same goal of fostering the advancement of basic science. Examples include offering prizes for scientists, providing scholarships and fellowships to train new scientists and supporting conferences or networks of scientists.

   This variation in programmatic efforts presents a serious challenge for assessing impacts and comparing the efficacy of different strategies within a portfolio. One funder acknowledged that in conducting "comparative analyses" of their portfolio of programs, staff "compare apples and oranges."

Limitations of current methodologies to assess investments in basic science

Funders highlighted several limitations of methodological approaches they routinely use to assess their portfolios of investments. Specifically, their remarks indicate that:

Self-reports from award recipients lead to concerns over subjectivity. One funder wondered, "Are people just giving you the answer you want to hear?"

Bibliometric methods may lead to underestimates of contributions, as authors often fail to acknowledge funders in publications or to display acknowledgments so they can be found easily.

Bibliometric measures focus on counts instead of quality of contributions; some propose "not counting the beans, but getting at the quality of the beans."

Expert panels are seen as the gold standard for assessing quality, but experts can be subjective and may offer "circular" reviews in "looking at the publication record."

Measurement designed for a specific audience is often re-purposed for others. When developing a measurement approach, funders need to consider the different audiences whose information needs require different types of evidence; these audiences could include the funders' boards of directors, program staff, the scientific and philanthropic communities or the general public.

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Toward an improved practice: Developing a robust measurement approach

The following considerations emerged as the group reflected on ways to improve current evaluation practices:

- **Articulating the desired impact more clearly.** Funders highlighted the importance of clearly defining the term "impact." For some, impact is making a discovery. For others, impact is the change that arises from that discovery. As one funder put it, "Knowledge doesn't mean anything unless it is used in some way…What change did that [knowledge] bring?" This funder emphasized a desire to complement efforts to measure impacts with assessments of the "direct and indirect contributions in basic science." Another highlighted the value of the "emotional" impact of scientific discoveries, how "they change our universe or worldview."
- **Aligning research questions with appropriate methods and indicators.** Mathematica presented an integrated combination of approaches to assessing investments that is anchored in a theory of change and designed to answer questions about monitoring progress, measuring outcomes, determining impacts and assessing broader influence. This integrated approach would leverage methodologies that best align with the specific measurement goals.
- **Learning from failure.** Examining failure is an important part of some funders' efforts to assess their investments in basic science. They noted that failure can help a funder "assess whether [they're] taking enough risk" in their portfolios or selection approaches. They also emphasized that much can be learned from negative research results and that sometimes, unintended results lead to big discoveries.
- **Determining the right level for measuring impacts.** Funders debated whether they should focus on measuring the impact of (1) their organization, (2) the research funded or (3) the individual scientists supported. Important distinctions emerged from the group, as some funders emphasized a desire to learn about the impact "of the foundation and of the research," while others underscored the importance of the individual "scientists doing the work."

NEXT STEPS

This work marks the starting point for further collaboration among funders of basic science research to strengthen monitoring, evaluation and learning practices to improve basic science philanthropy.

Organizations that participated in workshops in 2016 expressed a desire for a firmer and richer understanding of how their funding contributes to the advancement of knowledge in basic science. At the same time, funders recognize the limitations of current methodology and the need to accept some ambiguity in evaluation practices and findings.

As they continue working together, funders will seek to advance a more robust evaluation practice through case studies of current evaluation approaches across funders; sharing of useful monitoring and evaluation tools; and further research to advance relevant methodologies for assessing investments in basic science, and in particular, amplifying efforts to measure contribution versus attribution.

Topics for future discussion include (1) developing theories of change and logic models to support monitoring, evaluating and learning from basic science investments, and (2) exploring the role of expert opinion in evaluations of basic science funding.

Finally, some funders hope to engage a larger community of basic science funders through conference presentations and publications meant to further a more robust evaluation practice.

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