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What's Special about Basic Research?

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"Basic research" is often used in science policy. It is commonly thought to refer to research that is directed solely toward acquiring new knowledge rather than any more practical objective. Recently, there has been considerable concern about the future of basic research because of purported changes in the nature of knowledge production and increasing pressures on scientists to demonstrate the social and economic benefits of their work. But is there really something special about basic research? The author argues here that "basic research" is a flexible and ambiguous concept that is drawn on by scientists to acquire prestige and resources. She shows that it is used for boundary work and gives examples of the work it does in different situations by drawing on interviews with scientists and policy makers on the category of basic research and the changes they have seen in it over time.

Keywords: *basic research; boundary work; science policy*

"Basic research" is a term that is often heard in science policy without much apparent consensus on what is meant by it. Despite this ambiguity, and despite long-standing dissatisfaction and debate over the definition of the term, crucially important decisions are made on the basis of this concept. Money is allocated, power is gained, and status is achieved. More subtly and importantly, the world is divided into meaningful categories, and ideas about the nature and value of knowledge are legitimized. The ambiguity and dissatisfaction surrounding the term are initial indications that what we are looking at is a concept that cannot simply be defined in terms of its essential characteristics but one that is influenced by social factors (such as objectives, interests, and values). I argue here that "basic research" provides a flexible repertoire of characteristics that can be drawn on selectively by scientists and policy makers in a variety of contexts to protect their interests

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and their scientific ideals. In this manner, "basic research" is used for boundary work (see Gieryn 1983, 1995, 1999; Barnes, Bloor, and Henry 1996). From a boundary work perspective, what becomes interesting about a concept is "how its borders and territories are flexibly and discursively mapped out" (Gieryn 1999, 23) rather than how it is precisely defined. The aim of this article is to explore the various ways in which the heterogeneity of "basic research" allows it to be used for boundary work by actors to gain authority and resources. It does this by asking how the term is defined, justified, and used by scientists and policy makers. It goes on to look at how scientists and policy makers perceive that the research system is changing and how this is influencing the way the term is used. Throughout, the article is concerned with how actors describe and portray basic research and how they use the term rather than with the nature of the activity itself.

This article starts with a brief outline of the history of the concept of basic research. Then, interview material is drawn on to address the flexibility and ambiguity of the term by sketching out the space that "basic research" can occupy and by asking whether actors make use of different aspects of the term at different times. I examine the large variety of different ways in which basic research is defined and how its funding is justified. Then I turn to the way the term is actually used in practice and the work that it does. I show how scientists can use the term to protect themselves from evaluation and demands for applicability and in this way use it to protect their interests. This also brings up issues of who owns "basic research" and in which circumstances the term is useful.

Gieryn (1999) maintains that we should expect to see boundary work most clearly in situations in which boundaries are being contested. In the current funding situation, boundaries between basic research and other activities are being actively contested because of increasing pressures for applicability in scientific research. To address these issues, I examine changes in the funding environment and ask whether these are affecting the way the term is used. Here, the focus is on whether recent pressures for research to be socially or economically relevant have changed the way scientists and policy makers describe their research activities. I go on to ask whether we should introduce new terminology for categorizing research types, and I end with an analysis of the different ways in which "basic research" is used for boundary work.

Rather than focusing on how different theorists have classified and described basic research, I have examined the use of the concept among scientists and policy makers, thereby "shifting the task of defining science from analyst to actor" (Gieryn 1995, 418). The empirical material presented in this article is drawn from forty-nine semistructured qualitative interviews with twenty-four scientists (who do basic research) and twenty-five policy

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makers (who make decisions about which types of research should be funded). Half of the interviewees were from the United States and half from the United Kingdom. Of the scientists, approximately half were biologists and half were physicists. I aimed to get a diverse mixture of subdisciplines and seniorities in my sample of scientists. For example, the biologists were engaged in subfields such as plant physiology, molecular genetics, evolutionary biology, astrobiology, and fresh water ecology, while physicists were in areas as diverse as experimental particle physics, astrophysics, condensed matter physics, quantum physics, and medical physics. The scientists were funded from a diversity of sources, primarily the research councils (United Kingdom) or the National Science Foundation or the National Institutes of Health (United States), but also charities and/or industry.

Policy makers covered a broad range of actors including those in government who formulate policy and those in nongovernmental organizations who advise and influence government policy (such as Universities UK and the American Association for the Advancement of Science). Also included were representatives of learned societies (the Royal Society and the National Academy of Sciences) and advocacy groups (Save British Science). I talked to people in institutions that specialized in either biology (National Institutes of Health, Untied States; Wellcome Trust, United Kingdom) or physics (American Physical Society, United States; Institute of Physics, United Kingdom) or those who dealt with the whole of science (National Science Foundation, United States). I included those within government (Office of Science and Technology, United Kingdom; Office of Science and Technology Policy, United States) as well those who were further removed from direct governmental control (such as the U.K. Research Councils).

I could have greatly increased the size of my sample by conducting a survey rather than carrying out in-depth interviews, and a survey would have enabled me to test hypotheses involving predefined and easily separable understandings of basic research. But this would not have provided adequately rich material for exploring the nature of the concept and the contingence and flexibility of the term (see Calvert 2002).

History of the Term

A brief outline of the history of basic research provides some context in which to understand the development of the term and also explains some of the associations that it conjures up among scientists even today.

The Second World War and the cold war were critically important in the formation of the necessary ideological commitments and institutional

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arrangements for basic research. However, we can trace the notion back much further. Stokes (1997), in his analysis of basic research, starts with the ancient Greeks, tracing from German idealist philosophers the idea of the purity of the search for knowledge that is untainted by practical goals. Social class played a role in the search for knowledge that was not driven by sordid material motives. Since this activity could be pursued only by those who did not need external sources of money, the practitioners tended to be a leisured upper class who could finance themselves. These social connotations were carried through to the organization of scientific research in Europe, in which scientists had a status based on traditional elites (see Reingold 1991).

From a terminological point of view, by the late 1800s, the "sonorous and epistemologically laden adjectives" (Kline 1995, 196) "pure" and "applied" were widely accepted throughout the scientific community. But a problem was that the virtuous connotations of "pure" science were difficult for some of the increasingly important industrial and engineering researchers to accept. As a result, the term "basic" was introduced to replace "pure" (Kline 1995).

During the Second World War, the military and academics joined forces (Elzinga and Jamison 1995), and public funds became essential to science. The achievements of science during the war (along with arguments put forward by science advisers such as Vannevar Bush [1945] 1960), led to a situation in which the government funding of science was regarded as legitimate because society was seen to depend on the products of scientific research. The autonomy of scientists was simultaneously maintained because of the pervasive idea that scientific research would be most productive if left to scientists alone (see Polanyi 1962).[1] Autonomy over the research agenda was an important characteristic of the basic researcher following the war. Slaughter (1993, 284-85) describes the mythology of autonomy: "Basic science produced plenty only so long as university researchers were left alone, unhampered by demand for short-term results or particular products."

Elzinga and Jamison (1995, 586) argue that it has become clear that this understanding of basic research that stresses the importance of autonomy was "made from an internalist and positivist conception of science," where it was presumed that scientists could be completely autonomous and free from external influences in their research. Forman (1997) argues that during the cold war, scientists developed a self-image of what they were doing in an attempt to conceal from themselves the fact that they were working for military motives and to maintain an illusion of autonomy.

It was during the cold war, and during conditions of generous funding for researchers following Sputnik, that the public good justification for funding basic research was established (see Nelson 1959; Arrow 1962). The public good justification was often raised in interviews, as will be discussed below.

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The history of the funding of basic research from the end of the war to the present shows a move away from the belief that scientists should be supported as autonomous truth seekers, whose work will inevitably be beneficial for society, toward the view that scientists should gear their work more directly toward social and economic objectives.

We can, however, trace these pressures for applicability in the science system back many decades (although the rhetoric may have become markedly more explicit recently). In the late 1960s and early 1970s, there was a change in attitude toward research at the governmental level, as can be seen in the U.K. government report in 1971 that introduced the "customer-contractor" principle (Rothschild 1971). Similar movements were happening in the United States; "even in the 1960s and 1970s, questions of the social productivity and relevance of science increasingly attracted congressional attention" (Guston and Keniston 1994, 14).

During the 1980s, the emphasis on scientists to demonstrate the economic potential of their work meant that university presidents "redefined *basic* so that it had an applied dimension" (Slaughter 1993, 290) and was hence more accessible to industry. From the 1980s onward, there were pressures on nations to be competitive on a global scale, and we now have a situation in which "basic research has become intimately intertwined with production of goods and technological development of relevance for all realms of society" (Elzinga 1997, 420). Scientists, not surprisingly, try to use this wealth creation agenda as a way to obtain increased funds for their own research. Many theorists interpret this as a "decline in the importance of basic research" (Slaughter and Rhoades 1996, 334). One aim of this article is to look into whether these pressures for applicability have changed the way scientists and policy makers describe their research activities.

The Definition of *Basic Research*

To examine how current changes may be influencing the way the term "basic research" is used, first it is necessary to understand what is meant by the term. If "basic research," is used for boundary work, we should not expect it to have one simple definition.

The majority of the forty-nine scientists and policy makers interviewed used the term "basic research," often defining it in several different ways in one interview, showing that there are many competing understandings of the concept, even within the same individual. I identified six major ways of distinguishing basic research: epistemologically, intentionally, how remote the research was from applications, institutionally, and according to the

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disclosure norms and the scientific field. The two most important criteria the interviewees used to distinguish basic research, which I will briefly outline, were epistemological criteria and intentional criteria.

Basic research is often thought to produce a certain type of knowledge, and it is epistemological criteria that may seem the most intuitively obvious to use in defining it. The most common epistemological features my interviewees associated with basic research were unpredictability (sometimes referred to as novelty or uncertainty) and generality (i.e., solving a general problem will potentially help solve a wide range of other problems). Unpredictability closely relates to the justification for funding basic research because it can be characterized as the kind of pursuit that will result in "huge paradigm shifts" (U.K. policy maker) that will produce radical innovations.

In contrast, those who defined "basic research" in an intentional manner said that it is the motivation that drives the research that distinguishes basic research from other types of research. This idea lies behind the term "curiosity-driven research." Adopting an intentional definition can mean that if the same research is done with different intentions, it is classified differently. For example, "understanding how a cell grows would be basic, understanding how to grow it in your fermentor would be applied" (U.S. biologist). "Basic research" defined in this intentional manner is often defined in negative terms, for example, "If you don't know what you are going to do with the information then it's basic research" (U.S. biologist). Similarly, basic research can be thought of as research that is done for "no good purposes" or "merely Friday's entertainment" (U.K. policy maker).

What is significant about the intentional definition of "basic research" is that if the intentions behind the research are to produce something that will result in an application, no matter how fundamental the research may be in an epistemological sense, the research will no longer be classified as basic. If we adopt this intentional definition, we may come to the conclusion, as other theorists have done, that basic research is being threatened in the current funding climate.

These different methods of distinguishing basic research were not clearly separated from one another. One interviewee would often define "basic research" in one way but then use it in another in the course of the interview, showing that different definitions were often found within an individual.

No consistent differences could be found between groups in respect to how they defined "basic research," when analyzed in terms of country, profession (i.e., scientist or policy maker), or scientific field. This could be because the sample size was too small to identify any clusters of characteristics, but it also demonstrates that different groups exploit the many dimensions of the term.

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An important issue that arose when talking to scientists was that their idealized definition of "basic research" often did not square with how they described their own research experiences. For example, scientists who defined "basic research" in terms of curiosity-seeking intentions did not necessarily maintain that it was these intentions that drove them in their own research. Scientists often said they were motivated by a mixture of different aims, including wanting to find out more about their subject, doing good, gaining peer recognition, and "fun." They would talk differently when they were describing their own work from when they were discussing the idealized activity of basic research.

This behavior was also apparent in respect to autonomy, which, as noted above, is central to the history of basic research. Autonomy is closely related to the intentional definition of "basic research" because to do curiosity-driven research, the scientist's autonomy over the research agenda would appear to be a necessary requirement. However, surprisingly many of the scientists I interviewed, who described themselves as basic researchers, admitted that in practice their autonomy was limited. They would often initially maintain that they had complete autonomy in their work and then go on, when considering grant applications, for example, to admit that they did not have so much. One scientist, when I asked him how much freedom he had, answered, "100%. I can do whatever I want," but then quickly added, "that's a bit facetious because I do what the federal government, what the NIH [National Institutes of Health] funds me to do" (U.S. biologist).

When scientists discuss what they do in practice, they do not appear to be following their curiosity in an autonomous undirected manner. This suggests that the way scientists define "basic research" may not represent what is done at the lab bench. It also shows that scientists are subject to conflicting pressures (see Brunsson 1994); they have to raise money, so they are under funding pressures, but they simultaneously want to see themselves as autonomous, curiosity-driven researchers. This inconsistency is permitted by the flexibility of the term. This flexibility is particularly useful when there are external pressures to describe research in a certain way, for example, in applications for funding or when the legitimacy of government subsidy for basic research is challenged.

The Justification for Funding Basic Research

The definition of basic research in terms of its special properties is closely related to its unique status as an activity that requires government support, which means that the justification for funding basic research is tied

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up with its definition. In circumstances in which the government funding of basic research has to be justified, we see the heterogeneous nature of the term being drawn on. Both cultural and practical justifications were used in the arguments interviewees put forward about why their research should be funded because they are both part of the broad concept of basic research.

The most commonly used justification was the public good argument: that industry would not invest in basic research because they would not be able to capture the returns. It was pointed out that if industry did fund basic research, then the information would not be freely available and this would not be optimal for society (relying on the dubious presumption that all basic research produces freely available and nonappropriable information, and assuming Merton's [1942] norm of communism).[2]

Another important and related justification was that the results of basic research would eventually feed into industry and produce substantial economic benefits, which gives a first indication of the impact of recent pressures toward applicability on the rhetoric of scientists and policy makers. This was often illustrated with anecdotes. I heard the anecdote about Queen Victoria and Michael Faraday (Queen: "What use is this electricity?" Faraday: "I don't know, but someday it will be taxed") in four different interviews.

A further justification for funding basic research was that because of its unique characteristics, it would lead to radically new innovations. We saw the importance attached to unpredictability in the epistemological definition of "basic research." This definition was carried through to the way some scientists justified the funding of basic research, which they said would produce innovative and unpredictable outcomes.

All these economic justifications are geared toward the idea that basic research should be justified in terms of its potential use. Three interviewees echoed Weinberg (1963) by noting that it is possible to adopt a broader definition of external use than economic or social use. They pointed out that research could be useful (and to some extent applied) if it could be used in another area of science, which could itself be basic.

Several interviewees justified the funding of basic research on cultural grounds, often as well as on economic grounds. I was told that basic research was something that a developed country should do, in the same way that they should finance the arts, because it "captivates the human spirit and elevates it to a higher level" (U.S. physicist). Here, it seems that basic research possesses symbolic value and status beyond its merely economic value. The point here is that scientists draw on the breadth of connotations associated with basic research when giving reasons why it should be funded by governments.

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The Use of "Basic Research" as a Protective Resource

My interest in basic research originated because of the way the term was often and ambiguously used in situations relating to science funding. When I asked my interviewees whether they found the term similarly problematic, I found a wide variety of views about the importance (or the lack of importance) of the term "basic research" itself. Overall, it seemed to be most useful in situations in which the scientific and policy communities had to interact, and in these circumstances, traditional connotations of the term were drawn on to protect scientists from demands for evaluation or applicability.

Several policy makers thought the term was completely unproblematic. For example, it was defined as what a particular agency (e.g., the National Science Foundation) funds, or as what is described by the "Frascati manual" (Organisation for Economic and Co-operative Development 1993). They had no interest in the ambiguity of the term and were happy to use it in funding decisions. Other interviewees resisted making distinctions between different types of research. They thought that forcing research into categories of basic and applied could be unhelpful. A U.K. biologist said it "can be used to damn you if people want to."

Some interviewees recognized that the definition was subjective. A U.K. policy maker thought that the whole activity of trying to classify research types was rather pointless: "On a bad day its counting angels on the head of a pin, I mean, so what?" He elaborated, "You ask what an academic does at 9 a.m. on Monday morning, and when you're sitting in a library reading an article are you doing 'basic research' or 'applied research' or what the hell? And my guess is that for most people, for the people actually sitting in the library reading *Nature*, the question is irrelevant."

We can see that many actors doubt the usefulness of the term. A question that arises here is who owns the term? Policy makers tended to think that "basic" and "applied" are terms used by scientists, while scientists would say they use these terms only in funding situations. For example, a U.K. policy maker explained, "We talk about those distinctions largely because that's the way the scientific community talks about them and you have to use that language for people to understand you."

However, scientists frequently stress how they do not use "basic/applied" terminology on a day-to-day basis but only when they have to present themselves for assessment or when they are looking for funding. A typical scientist's response was, "I only talk about it when someone like you comes along!" (U.K. physicist). They are usually more interested in discussing the problem that they are currently working on. The above examples suggest

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that it is when the worlds of science and policy have to interact that the term is drawn on and that the concept is less of an issue when such an interaction is not taking place.

I was given examples of situations in which "basic research" was drawn on during interactions between scientists and external groups. A U.S. biologist explained how he used the term to isolate himself from those who he thought might be trying to find applicability in his work: "If I'm talking to someone who's from a commercial concern I will very quickly in the conversation use the term "basic." Just because I just want to make it clear to them that I don't foresee I'm going to have something patentable or anything else during some reasonable time span of my grant." If he uses the term "basic," it will immediately be understood that he will not have anything commercially profitable to offer. Describing research in this way can act as a shield against applicability and against the unwanted involvement of an external group.

Examples of this use of the term were also found at the broader program level. One U.S. policy maker gave the example of the U.S. Department of Energy whose "fusion program used to be applied and now it's all basic." When I asked why this was, I was told, "They think that there's not going to be any fusion power—there will not be an application for it in forty years." It was because the department realized that the practical outcomes were not forthcoming that it seemed easier to classify their research as basic. Furthermore, "If a program is evaluated as applied research it's going to get evaluated on the basis of how soon they achieve the goal of making things practical, so by making it basic they can perhaps defer the evaluation somewhat."

Classifying research a certain way has consequences for a particular kind of evaluation, associated with a particular kind of research. Again, this is an example of a situation in which scientists have to subject their work to external bodies and in which the term "basic research" can be a useful protective resource.

The term seems to be used in circumstances in which different groups are forced to interact in decisions about research. In these ways, it can be useful, and again, I would argue that this is because there is no one shared understanding of "basic research." It is a term that can be used in various circumstances by actors to protect their interests.

Tailoring

Another example of the work the term can do was shown when scientists demonstrated how they could use the flexibility of the concept to make

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their work appear more applied to gain funding and resources. By changing the way they portray their research activities, scientists are engaging in boundary work. Several interviewees described this activity as *tailoring*. In the examples of boundary work given above, scientists were using "basic research" to distance themselves from the applicability of their work, but in tailoring situations, they are doing the opposite and emphasizing the potential applications. What is interesting about these tailoring activities is that scientists will freely admit that they are doing them. They also maintain that in doing them, the actual content of their research is not being affected at all.

I saw clear examples of this phenomenon when scientists talked about increased pressures for applicability in grant applications. Some scientists find the whole activity of having to point to potential applications of their work burdensome. One U.K. biologist mentioned how it is necessary in grant applications to talk about the deliverables and improvements in quality of life that will result from the research. He said, "One has to generate a piece of verbal garbage or written equivalent of verbal garbage to answer questions like that. Which is I believe quite meaningless, of no value to anyone."

Several other scientists thought that the obligatory paragraph that has to be inserted into the grant application form was thought to be "a waste of paper as far as I'm concerned, but you know, it's a hoop you have to go through" (U.K. physicist).

This process of jumping through the hoop was said to involve "changing our priorities to match where the next pot of money is coming from" (U.S. physicist). A U.S. biologist said it is often necessary to bend the original research idea: "You take your basic research idea, and then you squeeze it into the programs that are available, because it's not always a good fit."

Scientists described in surprisingly frank terms how research could be portrayed as either basic or applied depending on the situation. A U.S. condensed matter physicist who specializes in foams explained, "You emphasize the importance of foams to industry and then you propose doing something. Whereas if it's for NSF [National Science Foundation] you emphasize the analogies with metals and biological tissues. . . . You can play it any way you like, it's the same research. For me its very beautiful fundamental physics but it's so close to a lot of industrial processes that it's very easy to write a grant that looks strictly applied."

A U.S. biologist describes how he changes his own work when the funding agency's focus changes: "We change the way we talk about what we are doing, we change the words we use to describe what we're doing. We're still doing the same thing, we just, we just now say instead of bioremidiation we're looking at biocatalysis. Same difference."

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A U.K. physicist says he found it necessary to generate the label *applied hypocrisy* for this kind of activity, which is "where you put some nice words at the beginning of everything you do which links it to something which sounds applied, but really you don't do anything whatsoever which is really applied and has any effects."

However, it is difficult to tell if many of these scientists were guilty of this applied hypocrisy or whether their work actually did have both basic and applied elements to it. One U.S. biologist gave an example that supports the latter hypothesis by showing that since "basic research" has such a large range of characteristics, it is relatively easy for scientists to emphasize some features rather than others. He described how a proposal he wrote "had good applied aspects to it because it deals with a real problem—the problem of declining salmon in streams and rivers—but it was good basic ecology and so we submitted it to the agency and they very much liked the idea because they perceived it as being solid basic research but having a good applied element to it as well." Since it has both basic and applied aspects to it, either characteristic can be drawn on depending on which is more likely to get the scientist the most funding.

Several scientists play down the extent to which they have to alter the way they portray their research in funding applications. For example, a U.S. biologist said, "Usually it's a very mild side-step you have to make. I've never had a problem with it." A U.S. physicist stressed that his priorities really do overlap with those of the funding agency: "So on the one hand the research is being tailored to suit the agency, on the other hand the agencies are facilitating the kind of research I want to do so it isn't all a negative thing."

It is interesting that this scientist is using the tailoring terminology in the context of emphasizing that the changes he actually has to make to his research are not dramatic. I heard lots of similar language, including thinking about "whether you want to put any political spin on it" (U.K. biologist), having to "dress yourself according to what the agency desires" (U.K. physicist), "hand waving" (U.S. biologist), and "bending" the research (U.S. biologist). What is important about all these terms is that they do not imply that the nature of the research is being changed substantially. These terms, by their very superficiality, are protecting the research from the necessary boundary work the scientists have to carry out (and are aware they carry out) to emphasize certain features of their research to get funding. It is interesting that the same strategies were used by both biologists and physicists and that there were no instances in which biologists consistently used the term in one way and physicists in another. "Basic research" appears

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to have sufficiently broad connotations to be made use of by those in very different disciplines.

Changes in the Funding Environment?

The above examples show that scientists can tailor their work to make it appear more applied and that they can do this because of the flexibility provided by the broad repertoire of features comprising "basic research." I have suggested that this is a response to increasing pressures for applicability in the current funding situation. However, not all interviewees thought that there was an increased emphasis on applied research at the moment; perceptions of changes in the funding environment varied considerably. The aim of these discussions was to elicit perceptions of changes in the funding environment, perceptions that influence the use of the term "basic research," not to examine how the science itself was changing or to measure funding pressures on researchers.

Many scientists were worried about a recent emphasis on applicability, as would be expected. A U.S. biologist talked about "basic research creep," saying that everything has to have more of a "tinge of applicability" nowadays. A U.K. physicist complained that "everything must be clearly useful and identifiable as useful now."

There were worries that this push toward applicability had changed the flavor of university research, that doing research that has to include an awareness of its potential uses will change the mind-set of the researcher and that this will not result in the best (i.e., the most unconstrained and unpredictable) science. Interviewees were concerned that science is becoming less risky and more short term. However, as the section on tailoring showed above, although scientists may say they are worried about these changes, in practice they are fulfilling the requirements of the funding applications and stressing the links to application in their own research.

Some scientists showed that they were specifically worried about the health of basic research in this situation. For example, a U.K. physicist expressed concern: "I think basic research in the U.K. is not being nurtured and may well not survive. I think to an extent the U.K. is living on the fat and momentum built up in periods when that sort of research was more valued."

Policy makers' views on the changes to the funding environment were notably different. Several policy makers (and only policy makers) tried to assure me that although there may be a shift toward "making people think just a little bit more about how what they're doing could be used in the future"

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(U.K. policy maker), this did not pose any real threats to basic research. They said that the research had not really changed in character, "but the people have just become more savvy about its potential for applications" (U.S. policy maker). The denial that the actual work being carried out by scientists is changing suggests that for policy makers, it might be important not to think of their administrative work as interfering with the purity of basic science.

Some interviewees thought that the funding emphasis was becoming more basic and less applied, showing that there was a diversity of views on this issue and no consensus on how current changes are affecting basic research. An applied U.K. physicist complained, "There are still referees and committees who are, shall we say, unsympathetic to anything that has applications." A U.S. biologist also pointed out that "the elitism of basic science still hangs around. There's still a lot of people, mainly older people, who still look on industrial collaborations as being slightly tainted and dirty, and it's prostitution to do applied research."

Again, we see ideas of the purity of basic research being important and having an impact on the ability of scientists to get funding, even today. We are also reminded of the symbolic and cultural value attached to basic research. The mention of older researchers here is interesting because in interviews, older researchers appeared to be much less concerned about the practical applications of their work than younger researchers were. This comparison should be treated with caution, however, because it is made on the basis of a small number of interviewees.

Discussions of changes highlighted a perception that the gap between the discovery of new knowledge and its application has narrowed markedly. A U.K. scientist pointed out that it is difficult to make a distinction between basic and applied research "because the speed of research is increasing, because the speed of moving from discovery to exploitation is increasing, and because the same individual people can be involved in any point of the cycle." In this situation, "you, the researcher, don't need a label." A U.K. policy maker mentioned biotechnology and pharmaceuticals in this context, saying that "there's such clear evidence from the pharmaceutical and biotech sectors of very rapid pull-through into application from basic research." This might lead us to conclude that close links between basic and applied research are discipline specific, but an analysis of those who stressed the close connections shows that this group included both biologists and physicists, and within these disciplines, many subdisciplines were represented. This suggests that we cannot assume that disciplinary or even subdisciplinary distinctions will help us understand how scientists interpret the distinctions between basic and applied research.

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This leads to the question of whether we should give up on the basic and applied labels completely. Several theorists have attempted to do so. Callon (2001), for example, divides research into emergent and consolidated networks. In emergent networks, which epitomize new scientific fields such as biotechnology and information technology, the knowledge is specific to the field and is not freely available. In more stable consolidated networks, the knowledge is linked to more nodes of the network and hence appears to be more general and widely applicable.

A New Terminology?

Such alternative schemes suggest that we should adopt a new terminology, and initially my aim was to develop a new categorization of research types that could replace the existing way of differentiating research activities. However, in discussing this with policy makers, I discovered that they would be unhappy with changing their categories because the current terms are so established in the policy landscape and they thought reclassification would be too demanding. It was argued that the current terminologies provided a useful shorthand and they are the established categories used in reporting to government. It was considered very hard to get any agreement on alternatives since if a new suggestion is put forward, it is not clearly "prettier than the one on the stage" (U.S. policy maker).

Policy makers do not see pressures for applicability in the current funding climate as fundamentally changing the nature of basic research, and they do not think it is necessary to change the way we describe it. But this shows that the term, as it is, is important for them, and we can speculate about the reasons why this might be so. Perhaps retaining the concept of basic research keeps the scientific community happy, by giving the latter the impression of control over the research agenda, while policy makers can deny that changes are having negative effects if these changes can go on behind the label "basic research."

Another reason why policy makers may want to keep using "basic research" may be because political agreement about applied goals is harder to achieve since this would constitute "picking winners," whereas "it is clear that everyone agrees we have to fund basic science" (U.K. policy maker). A similar point was made by U.S. policy makers, one of whom said that one of the reasons why the term *strategic research* had become unpopular in recent times was because "it means picking winners and losers" and the present[3] Republican-dominated congress objects to the involvement of

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government in industrial research. In this context, once the clear distinction between "basic" and "applied" is blurred, the justification for funding research is lost, because if research is seen to be too applied, its potential appropriability by industry becomes an issue. In practice, making this distinction was not easy; a U.S. policy maker said that "it is difficult to decide where the line is—politically." But there are many advantages to drawing such a line. "Basic research" carries connotations of independence from social demands (although this may more accurately be described as "dependence in the guise of independence," as Bourdieu [1975, 35] puts it), and the public good justification for funding basic research relies on the assumption that basic research is an activity that is nonappropriable by industry.

There are other reasons that help explain the attachment policy makers have to "basic research." Pragmatically, policy makers do not have to disrupt a whole set of categories if they retain the concept. This came up in discussion when a U.K. policy maker questioned the usefulness of my attempt to analyze what he meant by "basic research," saying, "I'm not sure what value there is in prodding that one too much." This is an example of "how some cartographies get stabilized as unquestioned tacit assumptions" (Gieryn 1999, 34-35). "Black boxing" the concept of basic research is obviously easier and more efficient for these policy makers than attempting to prize it open (see Latour 1987). By sticking to the old classification scheme, we can happily compare statistics across countries, even if the nature of the research itself is changing.

Boundary Work

I have shown in the examples above that because the boundary of "basic research" is so flexible and contingent, it can be used in many different ways. In some circumstances, scientists and policy makers appear to draw on the same connotations of the term but from different vantage points. They use it to protect the image of an idealized pure, autonomous, and undirected basic science from apparent involvement and engagement with external bodies and demands. Figure 1 is a diagrammatic summary of the boundary work being undertaken by both scientists and policy makers in the situation in which they are trying to draw on the (rather anachronistic) ideal of basic research as an activity in which scientists can autonomously pursue their curiosity.

As we saw above, scientists use the term as a protective resource, to shield themselves against demands for applicability and evaluation from external bodies. Policy makers, on the other hand, use the concept to deny that their activities are having any negative effect on scientific work.

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Figure 1
***Basic Research* as a Boundary**

Scientists	*Basic research*	**Policy makers**
"Leave us alone"		"We are not interfering"
(Protecting themselves against demands for applications)		(Denying that what they do has any effect on the autonomous activities of scientists)
But they are making their research appear more applied		But they are demanding increased applicability

"Basic research" can be used in ways that suit both groups simultaneously. Since the policy makers I interviewed thought that the arguments that are currently used to justify the funding of basic research are convincing to politicians, this implies that there is no incentive for them to change the way basic research is described or justified.

However, as shown above, changes are occurring, and this is indicated in Figure 1 by the dotted line. The boundary between scientists and policy makers is not a stable one. Scientists do attempt to make their work appear more applied because they perceive it will get them more resources. Policy makers are demanding more applicability from scientists in the results of their research, even if they claim that their activities are not affecting scientific research. There is a perception on both sides that the funding situation is changing, and these perceptions are influencing behavior.

Because of the breakdown of the boundary shown in the dotted line in Figure 1, there is a demand for more complex boundary work. This double boundary work is depicted in Figure 2, and in this case, it is boundary work by scientists only. Scientists engage in this more elaborate boundary work, while policy makers do not, probably because they are more aware of the ambiguity of the concept and because basic research is an important constituent of their self-image. In Figure 1, scientists are drawing on traditional ideals of basic research, but they can simultaneously draw on completely different aspects of the term in the attempt to make their work appear more

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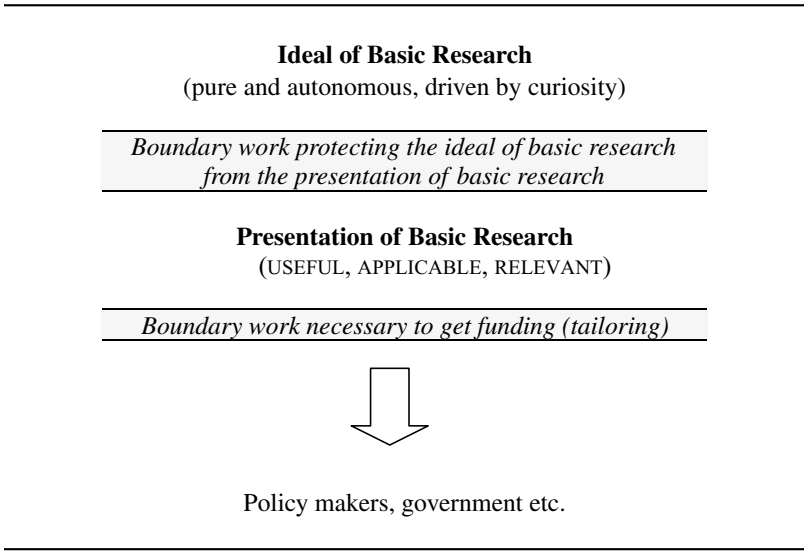
Figure 2
Double Boundary Work



applied. Despite the fact that scientists tailor their research in this way, they simultaneously manage to protect the purity of basic research by putting up a boundary between what they do to get their work funded and their ideal of basic research. They admit that they are tailoring their definition of "basic research" to make it fit with certain demands for applicability, so they admit that they are actively involved in boundary work at this level ("boundary work necessary to get funding" in Figure 2), picking and choosing which characteristics of their research they present to their audience of funders. But at the same time, they deny that their tailoring activities are influencing the content of the work they are doing since they see them as just "window dressing." In this way, they are protecting their cherished notion of basic research with another boundary that separates their everyday research activities from their ideal of basic research.

In Figure 2, the ideal of basic research gives scientists an autonomous space for following their own curiosity, and it also has a historical tradition of being a respected activity. It is the flexibility and ambiguity of the term that enables it to apply simultaneously to the ideal of basic research and the apparently inconsistent presentation of basic research as potentially useful, applicable, and relevant.

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We saw above that scientists would describe basic research as autonomous work that was driven by curiosity, while at the same time admitting that their own work was far from autonomous and that they were motivated by many different aims apart from curiosity. Despite this, they still feel a need to retain the ideal of basic research. Geertz (1973) says that the importance of ideologies is to make situations meaningful, and it is irrelevant whether ideologies are correct representations of reality or not. By defining themselves as engaging in the ideal of basic research, scientists are making their actions meaningful for themselves and legitimizing their activities.

There are parallels here with Mulkay's (1976) interpretation of Mertonian norms. According to Mulkay, scientists use the rhetoric of norms in different ways in different circumstances, much in the way I have suggested they use the term "basic research." The norms are part of the language used for presenting science to the outside world, and they do not always accurately reflect or guide behavior. In this case, we have seen that basic research as a scientific activity is described differently from basic research as presented to the outside world.[4] Like Mulkay, I am arguing that basic research is an important constituent of a broader ideology about what research should be and that it is intricately tied up with the image that is projected about what it is to be a scientist.

It is interesting that this image is one that is shared across disciplines. Although we should be wary of treating scientists as an undifferentiated group (see Bourdieu 1975), it does appear that scientists pull together and defend basic research when they reflect on it. We might think that since molecular biology and the biomedical sciences are at the forefront of new technologies and have a great deal of popularity with current governments, while physics has steadily suffered since cuts at the end of the cold war, this would mean that there would be different pressures operating in the different disciplines. However, comparing biologists and physicists shows that differences were not marked and that both groups have similar ideas about the nature and value of basic research. This could lead us to a tentative conclusion that the ideology of basic research is shared across disciplinary divides. It seems that the value of the pursuit of knowledge for its own sake is something that it is in the whole scientific communities' interest to endorse.

Conclusions

This article has shown that the heterogeneity of the concept of basic research allows it to be defined, justified, and used in various ways by scientists and policy makers. The situations in which the term seemed to do

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the most work were those in which the scientific community had to interact with the policy community or with some other external group.

It was not universally agreed among interviewees that there are currently increasing pressures for basic research to be more relevant and applicable; there were differing opinions on this issue, and the aim of this research was not to study the changing nature of the activity itself. However, it appears that perceptions of changes in the funding environment toward applicability do seem to have affected the justification and use of the term.

Even though the category of basic research is a relatively recent one constructed to fit the cold war context, it is one that happily coincided with some profound ideas about the nature of scientific research (in a similar way to how Christmas happily coincided with a pagan ceremony). What I hope to have shown here is that the image of the autonomous seeker after truth is still relevant today, and it is something that scientists protect with boundary work.

The consequences of the persistence of "basic research" for changes in the funding environment can be pursued further. I have shown that the concept will continue to be important and that there is considerable resistance to changes that threaten to undermine fundamental scientific ideals, resistance that crosses disciplinary divides. I have shown how essential it is for scientists to retain the meaningful values they attach to "basic research" and how even policy makers want to keep the term because it serves useful functions. To better understand the changing nature of knowledge production (see Gibbons et al. 1994), we should be more aware of the complexity of actors' reactions in situations in which values and interests are involved.

By using a boundary work approach and applying a science studies perspective to the categorization of research types, which has been largely the domain of science policy, it is possible to reveal dimensions of "basic research" that have previously not been addressed. A boundary work analysis has shown that it will be extremely difficult to ever precisely define "basic research" or identify what is unique about it, because how "basic research" is defined will depend on the circumstances in which it is being used to do boundary work. Rather than coming up with essentialist definitions of "basic research" or water-tight justifications for its government funding, I have attempted to show how the term is used in different ways by different actors and to examine the work it does. It is in these ways that "basic research" is special, rather than because it possesses unique features. The aim here has been to demonstrate how an apparently ambiguous and unsatisfactory term actually becomes useful in practice. This suggests that there is room for an increased role for science studies in the future analysis of science policy issues.

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Notes

1. However, this article can be interpreted as a response to Bernal and other left-wing scientists of the time (who were in favor of greater government involvement in science) and a plea for the independence of scientists.

2. See Callon (1994) for criticisms of the public good argument.

3. U.S. interviews were carried out between September and December 1999.

4. This has similarities to what Brunsson (1994) calls "double talk," in which organizations develop "different ideologies of external and internal use" (p. 7).

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