U.S. SCIENCE POLICY

Agencies Scramble to Measure Public Impact of Research

The Davenport, Iowa, office of the National Weather Service (NWS), which opened in 1995, had a pretty good rookie season: Its staff of meteorologists successfully predicted all 12 tornadoes that touched down in the area and gave residents an average of 30 minutes to take cover. In the past, NWS officials might have settled for a press release announcing their perfect batting average. But this year NWS's success has been incorporated into a self-report card to help its parent agency, the National Oceanic and Atmospheric Administration (NOAA), comply with a 3-year-old law intended to make sure taxpayers get the biggest bang for their buck.

NOAA is in the forefront among federal research agencies in looking for quantitative ways to measure its scientific achievements under the 1993 Government Performance and Results Act (GPRA). Indeed, NWS's work—including a 1995 record of forecasting tornadoes and hurricanes that exceeded its own targets—was cited in a recent General Accounting Office guide (GAO/GGD-96-118) to implementing the law as an example of an agency that has identified its mission, set out goals, and drawn up appropriate yardsticks to measure its progress. "For years we were ridiculed for making forecasting an integral part of our efforts," says Louis Uccellini, who heads NWS's office of meteorology. "But now the science has matured to the point where we can do this in a way that benefits the public."

Forecasting the weather may be tough, but at least it is quantifiable. For most agencies, however, it is harder to find tangible ways to measure the payoffs of their research. Next week, the House Science Committee will hold a hearing to learn how civilian science agencies are responding to the law. Officials from a half-dozen agencies are expected to describe their struggle to find useful measures of progress that will satisfy Congress without trivializing the science they fund.

The law was passed as a bipartisan attempt to make government work better by forcing agencies to set outcome-oriented goals and track their progress (*Science*, 6 January 1995, p. 20). Although its provisions don't kick in fully until next fall, agencies took a major step toward implementing it last month, when they sent the White House Office of Management and Budget (OMB) a strategic plan that includes long-range goals and measurable outcomes. In the fall, agency officials will supplement their 1998 budget requests with an explanation of how they intend to measure progress toward those goals, as well as a plan to assess that progress. Next year every agency must link its 1999 budget request to such measures, and in 2000 the first annual report cards are due.

HOWARD BLUSTEIN/PHOTO RESEARCHERS

In the wind? Measuring its ability to predict tornadoes is one way NOAA hopes to satisfy new law.

Despite NWS's success in conforming to GPRA's mandate, the science of severe storms illustrates two of the biggest problems that the law poses for research agencies: teasing out a single agency's contribution to a larger effort, and measuring a result that may not show up for decades. Uccellini is quick to note that other agencies have played an important role in increased understanding of the behavior of severe storms. The National Science Foundation (NSF), for example, spends more than $50 million each year on research centers in Colorado and Oklahoma that analyze the fundamental forces that produce such atmospheric turbulence, and the Department of Energy and NASA also support research aimed at protecting satellites and nuclear power plants. NSF also helped NOAA develop a new Doppler radar system that identifies precursors to the deadly vortex that drives a twister. "If you had told me in the 1970s that we would be able to do this in 20 years, I'd have laughed in your face," Uccellini says. "This is the result of a lot of good science by a lot of people."

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> **—Susan Cozzens**

Thinking about how to measure such accomplishments and give credit for them has become a regular concern for a small group of science administrators. About 30 meet each month to discuss the metrics of productivity and plan how to comply with GPRA. These agency representatives are struggling to find common tools, while trying to avoid duplicating one another's efforts. So far, however, many of the metrics they have developed—employee training, research facilities, international collaborations—seem more like way stations along the road to accomplishing an agency's mission. These surrogates for productivity may not satisfy Congress, says a consultant who works on performance-based management issues. "You need to understand that some of the people who want answers won't be supporters of research," Larry Cooley of Management Systems International in Washington, D.C., told the group. "It's not enough to say that an agency is trying to build research capacity, for example. People don't care about a potential [benefit] until it manifests itself."

The more basic the science, the harder it is for an agency to quantify its activities. The law allows agencies to offer nonquantitative metrics for activities such as research, and NSF officials have already asked OMB for permission to use such "alternative" measures. One approach would be to alter the reporting forms that scientists submit at the end of a grant. Instead of giving a perfunctory 200-word response, as investigators often do now, they would be asked to explain in more detail not only what they have accomplished but also how the results were disseminated and who benefited from them. Already, a few volunteer institutions are planning to submit this kind of information electronically, starting this fall. NSF hopes to use the data to help make its case before Congress or the public.

The new reporting practices, if adopted, might allow officials to drop a current requirement—a 5-page portion of every application that asks scientists to explain the results of prior NSF funding. "We want to avoid having investigators feel that we're adding to their burden," says Susan Cozzens, head of NSF's planning office. In addition, NSF is thinking of creating a handful of broadly focused panels of outside experts to look at large chunks of NSF's portfolio; currently, there are 180 or so committees of visitors that review the operational details of every NSF program in 3-year cycles. The reports of these new panels would contribute to the agency's overall assessment of its performance. "The goal is to produce new insights at as low a cost as possible," says Cozzens.

NSF isn't the only one looking for alternatives: Officials at the National Institutes of Health (NIH) would like to adopt similar qualitative measures and are waiting anxiously to see if OMB grants NSF a waiver to use them. "If we can't use that approach, then OMB may end up with gobbledygook," says NIH budget chief Francine Little. Rather than invent new metrics, NIH officials say they would be more comfortable using tried-and-true methods such as getting input from peer panels and advisory bodies to evaluate their research programs. "GPRA isn't rocket science, after all," says Cherie Nichols, planning officer for the National Cancer Institute (NCI). "It's just good planning and evaluation."

Still, NCI is already experimenting with quantitative measures. Last month, it issued its annual budget request to Congress in a format that closely resembled GPRA: It set five goals for additional spending and spelled out quantifiable criteria that Congress could use to measure its success, such as identifying every major cancer gene within 5 years.

But NCI's document was developed independently of GPRA, says Lana Skirboll, head of NIH's policy office, and that made it easier for the institute to propose quantifiable targets. "If Rick [Klausner, NCI's director] falls short, then it's a lesson learned with little pain because it's his goal," says Skirboll. "But if that happens to NIH [under GPRA], then OMB and Congress will hold us accountable. And that could be a lot more painful."

Painful or not, GPRA has become a fact of life for all federal agencies. It is part of a mandate for change that is sweeping the federal research establishment and, like a tornado, it's a force that cannot be ignored.

–Jeffrey Mervis

SCIENCE HISTORY

Auguste D. and Alzheimer's Disease

New diseases do not suddenly present themselves, ready labeled, in a new patient. They emerge slowly from the collection and interpretation of clinical observations and physiological measurements. Think of AIDS, the many symptoms of which baffled the medical establishment for years before it was recognized as a distinct disease. Now the discovery of a long-lost file is providing medical historians with the original observations that led to the recognition of another modern plague, certain to worsen as the population ages (see special section on Aging starting on p. 41): Alzheimer's disease. Ironically, it appears that the original patient might now be classified as having a different dementia.

The file, which has been missing since 1910, is that of a 51-year-old female patient, called Auguste D., who in 1901 came under the care of the German physician Alois Alzheimer at a Frankfurt hospital. Last December, psychiatrists Konrad Maurer, Stephan Volk, and Hector Gerbaldo of the University of Frankfurt, Germany, were surprised to find the hospital file in the archives of their university psychiatric clinic. The blue-colored cardboard pocket, still in pristine condition, contains photographs of Auguste D. and samples of her attempts at a signature. There are also several pages of Alzheimer's handwritten notes, in a now-outdated German script, documenting in detail his patient's behavior during the first 5 days of her hospitalization, and other pages by two colleagues describing subsequent changes in her condition.

Dr. Azheimer's patient. A 1902 photograph shows Auguste D.'s helplessness.

"It's fantastic," says neuropathologist Bengt Winblad of the Karolinska Institute in Stockholm, Sweden; "it will clarify the symptoms of the patient." And they are not quite the same as the textbook symptoms of Alzheimer's. "Here we've got the real thing, in Alzheimer's hand, and this confirms that the clinical symptoms were more complex [than what we now call Alzheimer's disease]," says neuropsychiatrist German Berrios of the University of Cambridge, U.K.

Auguste D. was admitted to what was then Frankfurt's Hospital for the Mentally Ill and Epileptics in 1901 and stayed there until her death in 1906. Her answers to Alzheimer's simple questions reveal her confusion. The first page of the file begins as follows:

(She sat on her bed with a helpless expression)
"What is your name?"
"Auguste."
"Last name?"
"Auguste."
"What is your husband's name?"
"Auguste, I think."

Samples of handwriting show that she was also unable to write her own name without being reminded what she was doing. After 5 days of conversations and tests, Alzheimer concluded that Auguste D. suffered from progressive cognitive impairment, speech and perception problems, hallucinations, delusions, and psychosocial incompetence—symptoms of senile dementia, but occurring at an early age. She continued to deteriorate until her death, four-and-a-half years later, from septicemia arising from bed sores.

At that time, an autopsy revealed that her brain was atrophied, and staining the brain tissue with a silver-containing dye showed that it was studded with abnormal structures called neurofibrillary tangles and plaques, now considered the most characteristic symptoms of Alzheimer's disease. But the autopsy findings also included one that today is a criterion for exclusion from a diagnosis of Alzheimer's: arteriosclerosis, which was prevalent in the smaller cerebral blood vessels.

Although Alzheimer described Auguste D.'s symptoms and pathology at a 1906 meeting of psychiatrists in Tübingen, Germany, and in a brief paper published in 1907, it was another psychiatrist who put Alzheimer—and Auguste D.—into the history books. In the early 1900s, other psychiatrists, including Gaetano Perusini, E. Sarteschi, and F. Bonfiglio, had documented patients with similar symptoms. But historians trace the naming of the condition marked by those symptoms to Emil Kraepelin, director of the Royal Psychiatric Clinic in Munich, where Alzheimer moved in 1903. It was his colleague's description of Auguste D. that Kraepelin chose to mention as "this Alzheimer's disease" in his influential psychiatry textbook published in 1910.

From then on, the eponym stuck—even though part of Auguste D.'s dementia might have been caused by multiple blockages in small blood vessels due to arteriosclerosis. Neurologist Luigi Amaducci of the University of Florence, Italy, is just one of the clinicians eager to make a new diagnosis by examining Auguste D.'s file: "To have the original ... would make more interesting the hypothesis I'm putting forward, that [Auguste D.'s] clinical symptoms are still open to interpretation." Maurer, meanwhile, is trying to track down Auguste D.'s brain in hopes of finding a more definitive answer.

–Claire O'Brien

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