Why Social Science Matters for
INDUSTRY & BUSINESS

DEVELOPING INTERNET SEARCH ENGINES

With a market capitalization of more than $570 billion, Google is the world's second-most valuable company. Google's economic value rests on two pillars: its search engine, which processes over 3.5 billion search queries every day, and its advertising network, which features nearly 30 billion ads per day. Both these capabilities are based on developments in the social and behavioral sciences. Research cited in Google's patent was supported by four federal science agencies, including an $81,800 grant in 1984 from the sociology program at the National Science Foundation (NSF) to study networks of corporate board members. The original version of the search engine resulted from a formula developed with NSF funding in the late 1990s by two graduate students.

IMPROVING SAFETY IN THE AIRLINE INDUSTRY

Airline accidents have decreased dramatically over the past 30 years. This reduction is partly due to improved aircraft crew training that is based on fundamental social and behavioral research. The airline industry used this basic research, in combination with applied research conducted in cockpit simulators and analyses of actual cockpit flight recordings, to develop a training program called crew resource management or cockpit resource management (CRM).

Other industries have copied and tailored CRM techniques. For example, medical schools and hospitals in the United States and around the world now teach and use anesthesia crisis resource management, which draws on the principles of team training. Firefighting crews and emergency responders have also applied CRM principles and training.

USING THE ALTIDUES OF THE WORLD POPULATION TO INFORM PRODUCT DEVELOPMENT AND MARKETING

In 1998, researchers developed an entirely new mapping technique that divided the earth into grids that were indexed by population size and by altitude. Many private firms became interested in the findings of this research because of the implications of altitude on several types of products. For instance, Frito-Lay used the data to understand the market for its products at different altitudes because air pressure in packaging needs to be different at different altitudes. Procter & Gamble also had an interest in the altitude distribution because soap and bubbles form differently at various altitudes. Intel was similarly interested because its computer chips cool differently at various altitudes.

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Why Social Science Matters for
NATIONAL SECURITY

TERRORISM AND COUNTERTERRORISM

The National Science Foundation (NSF) played an early role in supporting research on terrorism and counterterrorism, beginning in the late 1980s. Recognizing that terrorists' behavior responds to counterterrorism policies in rational ways, this research used game theory to develop a model to inform counterterror policy. The U.S. Departments of Homeland Security and Defense have sponsored subsequent applications of this research. These applications have focused on government hostage negotiations; an evaluation of the International Criminal Police Organization (INTERPOL) cooperative program for combating international terrorism; the value of counterterror intelligence; and the first evaluation of the use of metal detectors to screen airline passengers.

FORECASTING POLITICAL INSTABILITY

NSF has funded research examining the root causes of political instability and indicators of early observable cues that a change in governance or political state is imminent. That research specifically studied cooperation and conflict, ethnic conflict, state stability, governance, and terrorism. Social science research was applied through support from DARPA and the U.S. Navy to create the Worldwide Integrated Crisis Early Warning System, which provides policy makers, operational commanders, and intelligence analysts insights and forecasts of changes in political stability.

SOCIAL NETWORK ANALYSIS FOR THE MILITARY AND NATIONAL INTELLIGENCE

Social network analysis identifies and allows people to understand the relationships among individuals, organizations, and entities. It can illuminate key characteristics of relationships, such as the frequency of communication, affiliation, and other social relationships. Social network analysis can be applied to telephone data, school records, organizational structures, or any other relationship-based data. Some NSF-supported research has combined social network analysis with automated text analysis techniques to provide valuable information about the patterns of behavior of hackers and the vulnerabilities of the nation's cyber networks. These tools analyze hacker chats and other data more efficiently than had previously been possible, with the potential to improve predictions about future threats that are based on hackers' intentions.

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PUBLIC HEALTH

DISPARITIES IN HEALTH AND MORTALITY

Social and behavioral science research comparing generations born in 1912 and 1941 showed that, between these two generations, life expectancy at age 65 rose by 6 years for people in the top half of the earnings distribution, but by only 1 year for those in the bottom half.

Some groups with lower levels of education have experienced rising death rates over the last two decades; opioids, suicide, and alcohol-related diseases have played a role in this trend. This and other findings about the health and mortality of the U.S. population provide important data for decisions about public health and government programs, such as Social Security, Medicare, and Medicaid.

THE HEALTH IMPACTS OF "TOXIC" STRESS & SOCIAL ISOLATION

Social and behavioral researchers and neuroscientists working together have found a variety of ways in which behavior and biology affect each other. For example, adversities in life and how people perceive those adversities can determine whether genes are "turned on" ("expressed"), setting up conditions that affect health over the long term. Poverty, violence, and other sources of stress early in life alter children's rapidly developing biological systems.

Research at the intersection of behavior and biology has also revealed that social isolation is a risk factor for early death, comparable in magnitude to well-established risk factors, such as smoking, obesity, and lack of physical activity. Identifying such risks in children before problems occur is critical for intervening early enough to prevent permanent damage to biological systems and avoid the costs they impose on individuals, families, and society.

CONTAINING EBOLA

Use of anthropological and ethnographic methods played an important role in containing the 2014 Ebola epidemic in Guinea, Liberia, and Sierra Leone. Anthropologists helped to save lives in these nations and to contain the disease, which had the potential to become a global threat. For example, because traditional methods of burial that call for the washing and touching of the dead are believed to have been responsible for 70 percent of new cases of infection in Sierra Leone, anthropologists developed a burial framework that allowed local people to see the body, but not have direct contact with it, and to include burial objects in the body bag prior to burial. The success of anthropologists as mediators in these situations led Doctors Without Borders to include anthropologists as part of their outbreak response to increase understanding and to facilitate relationships with local populations.

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Why Social Science Matters for
THE ECONOMY

NEW WAYS TO ENCOURAGE SAVING FOR RETIREMENT

Despite the rise of 401(k) and related investments that allow individuals to save through tax-deferred pension plans, employers found that surprisingly few of their eligible employees (only 30%) signed up ("opted in") to put any of their salary into those plans, even when their employers matched funds. A dramatic increase—to 90%—occurred as a result of a simple change: automatically enrolling workers and then allowing them to opt out rather than requiring them to opt in. Although this change may seem obvious in hindsight, it was informed by research on how people make decisions, process complex information, and think about the future.

MOVING FROM WELFARE TO WORK

Data from the National Science Foundation-funded Panel Study of Income Dynamics (PSID), an ongoing study of a nationally representative sample of families and individuals that gathers data on employment, income, wealth, expenditures, health, marriage, childbearing, child development, philanthropy, education, and many other topics, was used to determine how and why women moved off of welfare. While many believed that women left welfare through marriage, the data showed that most women left welfare through work. The PSID also showed that women on welfare worked much more than most people assumed, but that their work was too poorly paid to lift them out of poverty.

These findings influenced the inclusion in welfare reform legislation of work requirements on welfare recipients combined with programs to provide the work-based assistance women needed to care for their families and become self-sufficient. As a result, there was a significant increase in the number of single mothers who became employed and improved their own economic status and that of their children.

AUCTIONING OFF RADIO FREQUENCIES

The Federal Communications Commission (FCC) sells the radio frequency spectrum to companies that need bandwidth to transmit sound, data, and video to individual and corporate customers. Before the 1990s, the FCC used simple auctions, such as lotteries with random winners, from the list of all bidders. Then, beginning in the early 1990s, the FCC began using research (some of which had been funded by NSF's Social, Behavioral, and Economic Sciences directorate) that had developed mathematical principles to ensure that auction winners would pay a fair price. The FCC tested and adopted an algorithm to use with communication companies that allows companies to compete profitably but also ensures that consumers are not overcharged and taxpayers are not subsidizing unreasonable corporate profits. The additional government revenue from the initial auctions has been estimated at $60 billion; because this auction design was adopted by the FCC for later auctions and then spread worldwide, the estimated additional government revenue now totals about $200 billion.

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EDUCATION & WORK

UNDERSTANDING HOW PEOPLE'S CIRCUMSTANCES CHANGE OVER TIME

Studies of education, the labor force, and aging that follow people over long periods of time provide important information about the factors that may lead to life outcomes. One example is the Health and Retirement Study (HRS) of people aged 50 and older—the premier source of information on the nation's aging population. This large body of data from multiple sciences can help address a wide range of important questions about aging, such as how work, exercise, income, and other factors in middle age, affect circumstances in old age. Many countries around the world have modeled their own surveys after the HRS to understand their own aging populations. This type of research is made possible by access to large datasets—including data from federal statistical agencies and state administrative data systems—and helps to provide a more complete understanding of people and their well-being over time.

BILINGUALISM AND LANGUAGE DEVELOPMENT

A growing number of children in the United States live in homes in which a language other than English is spoken, leading to concerns from parents and teachers that speaking to their child in their home language will interfere with their child's ability to learn English and succeed in school. However, social science research demonstrates that learning two languages either at home or in an early child care setting neither confuses children nor puts them at risk for slower language development.

Indeed, social science research indicates an underlying human capacity for learning two languages as easily as one. Newborns as young as 0-5 days old can discriminate between the sounds used in different languages. In addition, adults and children who are competent in two languages may have some cognitive advantages relative to those who only speak one language, such as greater cognitive flexibility, greater ability to regulate behavior, and less cognitive decline at older ages .

THE IMPORTANCE OF WILLPOWER

A person's ability to delay gratification, to exert willpower, at an early age has surprising power to predict important outcomes in school and in life, according to social science research. A landmark study demonstrated that the longer that preschool children could wait for a reward, the higher were their later SAT scores, the better their emotional coping in adolescence, the higher their educational achievement as adults, the lower their rates of substance abuse, and the higher their sense of self-worth.

Social and behavioral research also uncovered a set of techniques that can help children delay gratification and control their impulses. When children learned these skills, their long-term outcomes as adolescents and adults were the same as those children who had initially been able to delay gratification.

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SCIENTIFIC PROGRESS

## SIMULATIONS, MODELING, AND FORECASTING

Models and simulations that apply theories and principles of behavior can be used to develop and test policy ideas and interventions quickly, inexpensively, and safely. Social science research has been incorporated into models and algorithms that forecast life expectancy, help businesses manage risk, and protect U.S. ports by preventing terrorist attacks and maximizing the detection of illicit and hazardous cargo. Social science research can now be applied to anonymized and aggregated datasets ("big data") generated by search engines, browsing logs, and social media posts to predict a wide range of collective human behaviors, such as consumer demand, unemployment claims, and mortgage default rates.

NEW METHODS OF COLLECTING AND ANALYZING DATA

Data collected from web–based surveys and smartphones can be biased and nonrepresentative. Social science research has begun to develop new models that use sophisticated statistical techniques for converting these inherently biased samples into unbiased estimates. These new methods could dramatically increase the scale, scope, and frequency of obtaining information from survey data by using real-time measures that draw on millions of responses to measure, for example, consumer or business activity, worker productivity, community well-being, or disease caseloads.

25%   65%   35%   85%

Respondent-driven sampling (also known as network sampling) is a relatively new method that allows researchers to collect important information about "hidden" or hard-to-reach groups, such as those at the greatest risk of infection from HIV/AIDS.
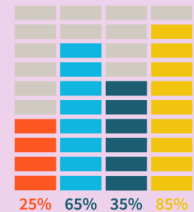
SHAPING OUR UNDERSTANDING OF HUMAN BEHAVIOR

The theory of "nudging" describes an approach to policy design that accounts for systematic, irrational tendencies in people's behaviors and decision making, building on Nobel Prize-winning work on the psychology of decision making. Nudging involves small changes in how choices or options are presented. These near-costless interventions can have remarkable effects. Examples that have yielded demonstrable results include changing the default on organ donation or retirement saving decisions from opt in to opt out (so that no action is required to be in the donation or savings pool) and notifying consumers about their neighbors' energy consumption. The individual and societal benefits of these interventions have been so large that both the U.K. and U.S. governments have established offices dedicated to implementing nudging approaches to a wide range of government programs, with demonstrated policy results.

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