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RESEARCH & IDEAS

MONDAY, AUGUST 17, 2020

## UC Berkeley researchers motivated by society, personal interests, scientific community



SALLY DOWD/STAFF

The Lawrence Berkeley National Laboratory is home to many of UC Berkeley's researchers, who go through detailed steps to ensure they produce high-quality work that leaves an impact on the scientific community.

BY [EMMA ROOHOLFADA](#) | SENIOR STAFF

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Part of every researcher's job is deciding what problems to work on.

The process of determining this is highly variable from researcher to researcher and can encompass a range of factors, including personal interests, societal need and funding. UC Berkeley faculty members have a lot of freedom in deciding what to research, but there are mechanisms in place to promote quality science, including the processes of seeking funding and peer review.

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UC Berkeley is a research institution, meaning alongside education, campus also puts a strong emphasis on its research sector. In fact, all campus professors are expected to conduct research or some “other creative activity,” according to Ben Hermalin, vice provost for the faculty.

### Types of research

All research can be split into two broad categories: basic research, which is conducted to acquire more knowledge about the fundamentals of a discipline, and applied research, conducted with the intention to produce real-world consequences based on scientific knowledge.

While the knowledge acquired through basic research can lead to functional applications down the line, the primary purpose of this type of research is the acquisition of more knowledge.

As such, the applications of basic research take longer to reach society than those of applied research do, according to economics professor Edward Miguel.

“I have other lines of research, for instance, on armed conflict, African politics, etc., where sure, there are definitely some applications to that research,” Miguel said. “But a lot of that research is really motivated by, more sort of, scholarly desire to understand the world better, you know, with the hope that by understanding the world better, we can make the world a better place.”

The type of research conducted can also depend on the nature of the discipline. Engineers, for example, are applied scientists by definition. They use the principles of basic science to build devices and solve technical problems.

Mechanical engineering professor Homayoon Kazerooni, who has developed marketable exoskeletons — wearable devices that assist people who have limited mobility — sees applied research as a more effective means of accomplishing his goals.

“There are urgent technological problems that need to be solved since the results would be life changing,” Kazerooni said in an email. “These problems are extremely difficult, much more difficult than just planning research for the sake of research.”

In other fields, such as political science or economics, researchers can conduct both basic and applied research.

### How researchers pick their problems

Many professors develop their research interests while they are in graduate school, when many of them first begin conducting independent research.

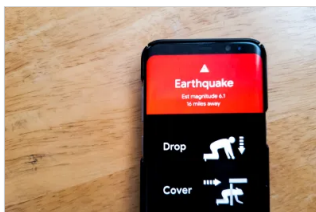
After graduate school, however, researchers can change their areas of focus. Psychology Alison Gopnik said her research has come in 10-year chunks, shifting directions with her changing interests.

The majority of research conducted at UC Berkeley is basic research.

“There’s definitely a very strong tradition at Berkeley of doing basic research,” Miguel said. “You can see that just in all the, you know, the tradition of Nobel Prizes and field medals and, you know, just the kind of seminal discoveries that have been made across so many fields.”

Campus administration stays out of the way when it comes to deciding what faculty should research, trusting that researchers know best about what problems to focus on in their respective fields, said economics professor James Robinson.

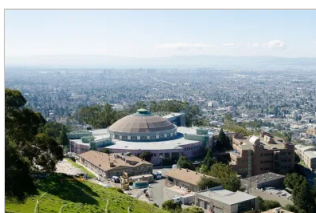
In this way, campus researchers have a large amount of freedom in how they carry out their research.



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While Nobel Prize-winning research can be a point of pride for UC Berkeley, it was not a motivating factor for campus professor Eric Betzig, who won the Nobel Prize in chemistry.

“I don’t give a damn about a Nobel Prize,” Betzig said. “I just want to do something that’s potentially impactful and fun to do and an interesting challenge.”

Betzig said he likes to research topics that do not get much attention but still have the potential to make an impact.

Aside from personal academic interests, faculty members also find research inspiration from current problems in society. Bioengineering professor Amy Herr looks for places where there is an “unmet need” when deciding what to work on next.

Similar to Herr, biochemistry professor Daniel Portnoy’s research is affected by societal needs, such as the need for an AIDS vaccine, which Portnoy began considering more than 30 years ago when the AIDS epidemic started.

Portnoy’s research has been guided by the same questions — how intracellular pathogens cause diseases and how hosts protect against them — for 30 years.

Although he is performing basic research, he does so with the goal that his work will later be used to develop beneficial applications.

### The stakes for researchers

Although faculty members are largely free to chart their own research paths, they are incentivized to perform high-quality, impactful research by UC Berkeley.

Both teaching and nonteaching campus research faculty members are evaluated for appointment or promotion by a committee composed of other faculty. The committee considers a faculty member’s success in teaching, in university and public service, in professional activity and in research or other creative activity.

For untenured teaching faculty members, how they perform on these evaluations impacts their likelihood of receiving tenure.

Guidelines for appointment and promotion can be interpreted differently based on department, but the appraisal committees are expected to evaluate the quality of published research and to factor in the input of other researchers within the field, among other measures.

Signs of successful research can vary based on the field. They can come in the form of prestigious science awards, research grants, publication in prestigious journals, patents or startups based on research findings.

These standards of evaluation allow campus faculty to benefit from conducting successful and impactful research, but determining what will be successful is not easy.

“If you’re doing pure basic science, which is what I do, then you just go into what you think the interesting problem is going to be. And that’s maybe the hardest thing that you do as a scientist,” Gopnik said. “You don’t know in advance which things are going to be productive and which aren’t.”

### Funding

For a faculty member who leads a research group, a major part of their job is applying for funding to support the lab and all its members.

Aside from campus evaluation, funding organizations serve as another research quality check, according to Herr.

“It’s kind of a nice bar,” Herr said. “It kind of grounds you in reality, like do I understand the science enough to develop a solid rationale and plan of approach that someone is going to support?”

Research funding comes from different sectors, including government, industry, nonprofit and campus. These groups have different missions that affect what they fund.

Governmental agencies account for about half of campus research funding. Some of these organizations, such as NASA and the U.S. Department of Energy, are aiming to fulfill more specific

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missions, while others, such as the National Science Foundation, fund research in a broader range of topics.

The NSF looks for research proposals that have not been done with the foundation's funding before, according to NSF spokesperson Rob Margetta.

"We have many more proposals that are ranked 'excellent' than we have money to fund them," Margetta said. "We are very careful that one of the factors we look at — and this is why we bring in those independent review panels — is novelty."

One reason some projects will not get funded is high competition. The National Institutes of Health, for instance, only accepts about 20% of proposals. The NIH also rejects proposals if there is a lack of innovation or if a project's hypothesis is deemed unprovable, among other reasons.

Some private organizations grant more freedom to researchers and "fund people more than projects," Herr said, citing the Chan Zuckerberg Biohub, where she is an investigator, as such an organization.

Although different organizations vary in the types of research they prefer, faculty members are generally able to find organizations that support the kind of work they want to do. It is a matter of finding the right ones to apply to.

Political science professor Eric Schickler said the NSF would most likely not fund policy-driven research, as it is a governmental organization, but he added that there are private organizations and think tanks interested in funding such projects.

### Peer review

With modern technology, researchers could hypothetically publish research online, free of charge to the public. Where a paper is published, however, affects how the scientific community perceives it.

For instance, in economics, research published in the "top five journals" is considered to have great impact, according to Hermalin. The journal publication process can be long, lasting anywhere between a few weeks and a few months.

Journal publication is highly valued because of peer review — the process in which other scientists assess and provide feedback on research before it is published — which is the most important research quality check, according to some researchers.

Once a researcher has finished writing a paper, they submit it to a journal. The journal is in charge of finding other researchers in the field to review the paper.

After receiving this feedback, the journal decides to publish or reject the paper, or it can have the researcher make changes to their paper, factoring in the new feedback.

Because of this, researchers must take into consideration different journals' evaluation criteria.

"To me, (novelty) is almost everything," said Abe Lee, editor in chief of miniaturization journal Lab on a Chip, in an email. "If it is a mundane, run of the mill research result, why waste time putting it together?"

### "Truth and replicability"

After completing this entire research process, researchers must wait to see how it impacts the larger scientific community.

Researchers are constantly building off the progress of others in their field, but this process can be very slow. Other researchers must see the work and decide whether or not they want to incorporate these findings into their own work. It then takes more time for those researchers to finish their own projects and cite others in their papers.

Because of this, it can take a while before a researcher realizes how other scientists have received their work.

"What leads to broader acceptance is replicability," said business professor Don Moore. "If a bunch of other people are publishing other studies that demonstrate the same result, that will increase faith in its truth and replicability."

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Moore added that he thinks some journals, however, prefer to publish results that are more “sexy and newsworthy” at the expense of the truth, which outspoken campus faculty members are advocating against.

Despite the instances in which Moore considers there to be misaligned incentives for conducting research, he said, ultimately, science remains “the best system we have for establishing truth.”

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