

CAREERS

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TECHNOLOGY

A lab app for that

Having a mobile device can save researchers a huge amount of time. It can also mean that they never switch off.

BY KENDALL POWELL

Phuong Pham's smartphone has given her more than just easy access to contacts, the Internet and social media. It has, she says, shaved months off her research projects. An epidemiologist at the Harvard Humanitarian Initiative in Cambridge, Massachusetts, Pham no longer has to lug reams of paper containing sensitive data into and out of conflict-ridden areas, and her data entry has been transformed. "We used to collect 1,000 10-page interviews, then manually

enter them into a computer, doing double data-entry to avoid errors," she says. Now, she and her team collect the data directly on their phones and simply upload them to a secure server every night.

Like millions of other users, Pham uses her smartphone to improve her daily efficiency by checking her calendar, task lists and e-mail on the go. But researchers can also now use smartphones and tablets to keep tabs on the scientific literature, track their experiments remotely and stay in contact with laboratory members. More than just mini-computers,

they have become digital notebooks that can be used at the bench and in the field. With several applications, or apps, particularly suited to researchers, gadget gurus say that mobile devices are much more likely to foster productivity than procrastination (see table).

NO MORE FILING CABINETS

Scientists deal with numerous manuscripts, and mobile devices allow them to read papers wherever they might be. Jaime Carvajal, a developmental biologist at the Andalusian Centre for Developmental Biology in Seville, Spain, says that he will sit in an airport lounge, in the cafeteria or in the living room and pick up his iPad just "as you would grab a journal to read".

Brenton Graveley, a molecular biologist at the University of Connecticut Health Center in Farmington, stores and organizes his PDFs using the app 'Papers', which also has a built-in PubMed search function and bibliography features, and is searchable by keyword, author name and journal title. The app allows him to read articles on his iPad and use the touchscreen to highlight text or make notes in the margins, then e-mail that annotated version to colleagues. Like many other apps, Papers can be synchronized among devices, so Graveley always has access to the most current version of his library. He says that it is easier to upload old literature into Papers than to look for it in his filing cabinet. And having his whole library searchable and at his fingertips meant that he could get rid of reams of paper. "I recycled thousands of hard copies of papers I had collected since I was a graduate student," he says. "It felt liberating."

Some researchers use the app 'GoodReader' for reading, marking up and e-mailing huge documents, such as doctoral theses, on their mobile devices. Many also use the free 'PubSearch' app for searching the PubMed database on the go and 'BioGene', which is also free, to search for the ID number and other information about a particular gene. But apps can do more than just organize information; they can help researchers to decide which information is likely to be worth their time. For example, the American Chemical Society in Washington DC has created the app ACS Mobile to send subscribers the most up-to-date research published in its 39 journals. "It's a very convenient way to keep up with the literature because you use bits of spare time to read the abstracts," says Eugenio Vázquez, an organic chemist at the University of Santiago de Compostela ▶

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Postdoc Miguel García Toscano uses his iPhone app to look up DNA amplification reactions.

▶ in Spain. Vázquez says that he would rather spend his transit time perusing papers than playing games. Similar apps from other journals are replacing e-mail alerts and the need to check individual websites.

Some scientists use their mobile devices to track the ‘buzz’ in their field through Twitter feeds, following big-name colleagues, breaking news and conference proceedings. “I’m finding it to be invaluable because I get more good information about research going on, links to articles and data sets than from any other source,” says Dawn Wright, chief scientist at Esri, a software company in Redlands, California. “I don’t have to wait for a major scientific meeting or go to someone’s website to learn about what my colleagues are doing.”

Apps can also help to navigate the buzz at big science conferences. Wright raves about the American Geophysical Union’s app, which is designed each year for the union’s annual meeting. The app lets conference attendees search the meeting abstracts and sessions, and ‘friend’ other attendees to message them directly. It also includes maps of the convention centre and information about local hotels and restaurants. “I hate having to carry these big folders and books around to all the sessions,” says Wright, who used the app at last year’s conference to coordinate dinner with friends and alert colleagues to interesting poster presentations.

LAB TOOLS

When it comes to doing bench work, various apps can help to save time. Carvajal uses ‘OD-260’ to convert optical units into nucleic-acid concentrations; ‘LabTimer’ to keep track of incubating test tubes; and ‘Notes’ to jot down experimental protocols. His phone gives him all the calculators, timers and notebooks he needs both when he is at his bench and roving between lab spaces.

Several reagent companies offer free time-saving apps. New England Biolabs, Qiagen, Promega and Bio-Rad have all created apps that provide useful formulae, conversions and recipes for common molecular-biology reactions to replace the paper pamphlets and catalogues that inevitably go missing from lab benches.

When doing calculations, ‘Mathematical Formulas’ and ‘Solutions’ can come in handy for looking up bits of information that were learned in school and promptly forgotten, such as the quadratic equation. Miguel García Toscano, a senior postdoc at the Andalusian Centre for Genomics and Oncological Research in Granada, Spain, carries his iPhone at all times, using it to look up DNA amplification reactions and take pictures of catalogue numbers he needs to remember.

Some pieces of research are best viewed on the bigger screen of a tablet. Carvajal uses his iPad to look up mouse gene-expression patterns in the Jackson Laboratory’s Mouse Genome Informatics database (informatics.jax.org). The screen allows him to instantly visualize almost all the known data on a mouse gene, including images of the gene’s expression in various tissues or stages of development in

a whole animal or embryo. “It’s an absolutely fantastic tool I could not do without,” he says.

With a bit of practice, the devices can help researchers to take and access huge volumes of notes. “I don’t take my laptop to conferences any more,” says Carvajal. “Just my iPad and iPhone and I’ve got everything I need.” He uses the ‘Bamboo Paper’ app and digital pen stylus to take notes and sketch diagrams while listening to talks. Graveley does the same with the ‘Notability’ app, which also records audio and time-stamps the recording whenever he makes a note or sketch.

Although computer programs have made digital note-taking a reality in the lab (see *Nature* **481**, 430–431; 2012), the apps on mobile devices are cheaper, although not as sophisticated. Toscano makes two copies of everything — he transcribes entries in his lab notebook into Word and Excel on his computer, then converts

USEFUL APPS FOR SCIENTISTS

App	Description	Compatibility	Price
Reference			
Micromedex Drug Information	Database of drug information and interactions and evidence-based medicine	Android, iPhone, iPod touch, iPad	Free
Mathematical Formulas	Database of basic and commonly used formulae	iPhone, iPod touch, iPad	£0.69/\$0.99
Solutions	Calculates volume, weight and molarity of chemical solutions	iPhone, iPod touch, iPad	£0.69/\$0.99
Lab tools			
MedCalc	Formulas to determine, for instance, body mass index, heart rate and iron deficiency	iPhone, iPod touch, iPad	£0.69
OD-260	Calculates nucleic-acid concentration	iPhone, iPod touch, iPad	Free
LabTimer	Count-up or -down alarmed timer	iPhone, iPod touch, iPad	Free
Organizers			
Papers	PDF organizer with PubMed search and bibliography features	iPhone, iPod touch, iPad	£10.49/\$14.99
GoodReader	PDF organizer that lets users read, mark up and e-mail documents	iPhone, iPod touch, iPad	£2.99/\$4.99
Wunderlist	Task organizer that allows information to be shared among colleagues	Android, iPhone, iPad	Free
Documents To Go	Converts Microsoft Office and PDF files to phone-friendly versions	Android, iPhone, iPod touch, iPad	Free on Android; £6.99/\$9.99 on Apple devices
Things	Task manager that syncs with desktop version	iPhone, iPod touch, iPad	£6.99/\$9.99
Alerts			
ACS Mobile	Publication alerts from the American Chemical Society	Android, iPhone, iPod touch, iPad	Free
Notebooks			
Bamboo Paper	Make notes and sketches	iPad	Free
Notability	Make notes and record audio	iPad	£0.69/\$0.99
Evernote	Make notes, capture photos, create to-do lists, record voice reminders	Android, iPhone, iPod touch, iPad	Free
Trello	Collaboration tool that allows users to see who is working on what part of a project through shared bulletin boards	iPhone, iPod touch, iPad	Free

the files to phone-friendly versions using 'Documents to Go' so that he can carry all his data with him and can check them when he meets with his supervisor. "Loading everything digitally is a time-consuming task, but it's helpful when writing a manuscript, and later on I appreciate it," he says.

But will the portability and capabilities of these gadgets ever replace traditional paper lab notebooks? Toscano is not convinced; electronic devices don't mix well with chemical solvents, and paper notebooks never run out of batteries. And when virtual notebooks are shared between multiple users, sloppy mistakes can accumulate and the work becomes prone to sabotage.

But Vázquez is testing those fallibilities using an online program called 'Evernote'. Most lab notebook programs, he says, are designed for industry use — to guard and time-stamp sensitive proprietary or patient information — and are "crazy expensive". But with a low-cost Evernote subscription, Vázquez can store any kind of file and data, up to 1 gigabyte a month, in an organized and searchable fashion on a server that automatically syncs 'notes' between his devices. Some of these services are available in the freely available program 'Dropbox', although Evernote has six times more storage and more organizing options. "My plan is to get a couple more accounts and to start testing shared notebooks with a couple of my students, which should make it far easier to follow their progress," Vázquez says.

Of course paper notebooks tend to stay in the lab and do not beep distractingly. The portability of mobile devices can mean that scientists never completely disconnect from their work. "That's the hardest thing about this technology," says Graveley. "You can be available 24-7." He frequently turns the sound off on his phone so that he is not reacting to every call, text message or e-mail alert that comes in. But resisting the temptation to play games or check e-mail constantly is no different from avoiding the vices on a desktop computer, Toscano says.

When the iPad first came out in 2010, Graveley offered to buy one for each of his trainees, but they all refused, sceptical back then of its value. "The utility of these mobile devices is based on the apps that other people develop, so you don't know what they're going to be capable of next," he says. Now, with an explosion of apps written by scientists for scientists and many available at no cost or for nominal sums, it is hard to imagine smartphones and tablets not eclipsing the laptop, notes Carvajal, who says he would like to see them in the hands of "every single graduate student and postdoc". ■

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TURNING POINT

Lisa Kaltenegger

Astrophysicist Lisa Kaltenegger is one of six recipients of Germany's 2012 Heinz Maier-Leibnitz Prize for early-career researchers. She divides her time between the Max Planck Institute for Astronomy in Heidelberg, Germany, and the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts.



What is the most important thing that you've done to shape your career?

Move to a new country. Through travel and unfamiliar experiences, I learned how to think differently and explore alternative approaches to science — important for any young person. I pursued master's degrees in both astrophysics and engineering, from the University of Graz in Austria and the Graz University of Technology, respectively. But I did the research for both in other countries. With Erasmus mobility funding from the European Union, I travelled for six months to the Institute of Astrophysics of the Canary Islands, Spain; we were trying to detect extrasolar planets using ground-based telescopes. I also studied biomedical engineering at Johns Hopkins University in Baltimore, Maryland, where the Graz University of Technology had an exchange programme.

So you considered going into medicine. Why did you choose astrophysics?

Both fields interested me because I wanted to have an impact on society — I wanted either to work towards a cancer cure or to seek another Earth. I had offers to do both. But I got a job opportunity at the European Space Agency (ESA), which was designing a mission to look for other planets, and I could see myself doing this fascinating job for a long time. It wasn't necessarily a logical decision, because astronomy can be a risky career path. But I had engineering as a fall-back option.

What was the highlight of your time at ESA?

Helping to design and optimize a mission to search for habitable planets. I had very little experience, but the team encouraged creative thinking and ideas. I had to model what the atmosphere of a habitable planet would look like to work out how to find one — insights that later helped me to get a PhD in astrophysics from the University of Graz.

You didn't publish much of your PhD work.

Was it difficult to get a postdoc?

I wasn't allowed to publish most of my work because the technology to look for planets was proprietary, and I couldn't very well publish

data without details on how they were obtained. I wasn't aware of this limitation when I started. But I was one of the few people working on exoplanet characterization who had a background in engineering, so I knew how to make trade-offs between instrument design and detection capabilities that wouldn't hamper the science and would keep costs down. Doing presentations at meetings and workshops connected me with Wesley Traub, an astrophysicist then at the Harvard-Smithsonian Center, who invited me to apply for a postdoc.

How did you end up with positions at both Harvard and the Max Planck Institute?

After finishing my postdoc at Harvard, I got an offer from Max Planck to establish my own lab, but Harvard wanted me to stay. Luckily, I had funding — a German Research Foundation Emmy Noether award, which helps early-career scientists to build a team and achieve independence. Because I had this funding, I suggested that I split my time between the two institutes — spending nine months of the year in Heidelberg and three months at Harvard. Exoplanet characterization is not something that many people do in Germany, so there is an extra incentive to maintain international collaborations.

You've won multiple awards. Will any have an impact on your career?

The young-researcher awards mean the most because they give early-career scientists credence and notoriety. In hierarchical systems, such as in Europe, they help to level the field a bit. The validation comes from being nominated by a peer who thinks your work is exciting. Whether you get the prize is often a gamble, but the positive reinforcement from peer recognition keeps you going. ■

INTERVIEW BY VIRGINIA GEWIN