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RESEARCH OPENS UP

THE WEB HAS MADE IT EASIER TO RECRUIT SUBJECTS AND REPRODUCE EXPERIMENTS, RESULTING IN LOWER COSTS - AND BETTER SCIENCE. BY GABRIELE PAOLACCI

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2013 is the year in which efforts to make research more open will finally bear fruit. Following a year of controversy in the world of science - including allegations of scientific negligence and misconduct, falsifying of data and overpricing by academic journals, public discussions are taking place, at conferences and on the web, about fixing some common guidelines for reporting and reviewing scientific results. Researchers are replicating past studies to assess their reproducibility. And the dissemination of knowledge is changing. Academic outlets often now require published authors to share their data and materials online. The success of free online repositories and open-access journals is putting pressure on academic publishers to reduce their prices. Access to knowledge is no longer to be considered a privilege.

Other developments are also making research more open, mostly thanks to the web. Imagine a psychologist who is interested in understanding whether implicit racial attitudes predict voters' intentions. Until recently, they would have needed to program complex software and recruit human subjects to go to a laboratory and participate in a study. This is inefficient at best, and cannot be done by researchers who lack computer skills, funding, subjects or laboratories. Open research,

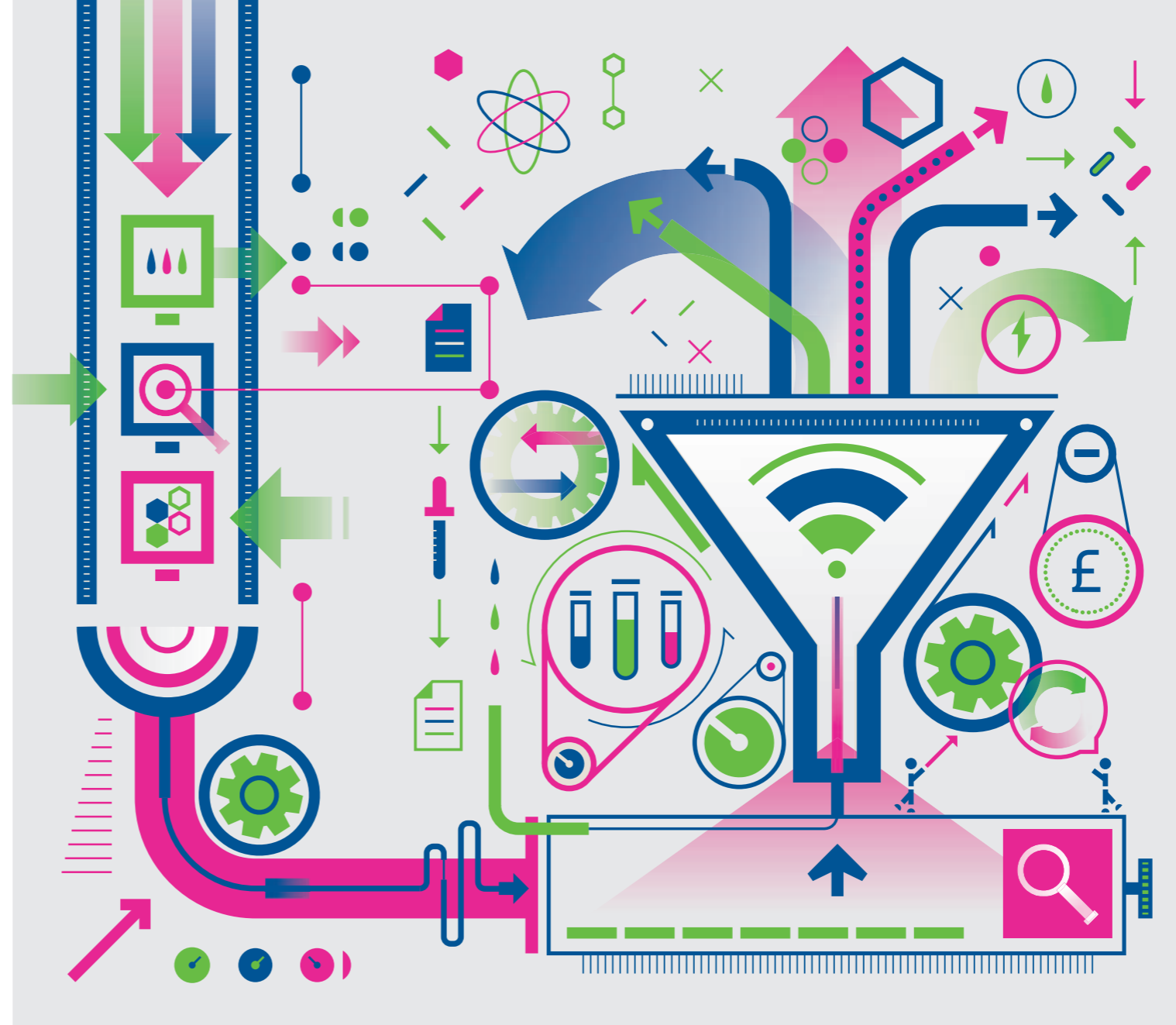
however, cuts through those difficulties. The required software - a program to run an Implicit Association Test - is already available in an open-source version on the web, shared by other scholars and requiring only minor tweaks to be adapted to the research question at hand. Z-Tree (for Zurich Toolbox for Readymade Economic Experiments) is a similar piece of open software for running economics experiments, and more packages are now appearing as researchers become more sensitive to the benefits of open science.

The recent debate around the reproducibility of research results is likely to foster even more voluntary sharing of (re)usable methods and procedures. The web is also opening up research through the increased use of crowdsourcing by social scientists. Online labour markets, such as Amazon's Mechanical Turk, are populated by hundreds of thousands of workers who have proved to be reliable research participants. More and more often behavioural researchers are acting as "employers" in such markets, recruiting participants and conducting surveys and experiments on the web. This opens up research in several ways. Geographic and financial constraints are almost entirely eliminated, allowing researchers without access to physical laboratories and large budgets to conduct previously unaffordable studies.

Relying on common pools of participants allows researchers to replicate other people's results and makes it easier for scientists to build upon each other's efforts. And not only researchers, but anyone can easily share materials, methods and data sources online. Research is finally going open. *Gabriele Paolacci is a post-doctoral researcher at Rotterdam School of Management, Erasmus University*

600°C

The temperature of a bomb-blast heat wave. A new silicone camo-cream will protect skin for up to 15 seconds.



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CROWDSOURCING OUR CONNECTOMES

ALONE, WE MAY LACK THE INTELLECT TO UNDERSTAND OUR OWN BRAINS. BUT JOINING FORCES WITH MACHINES WILL GIVE US THE EDGE WE NEED. BY SEBASTIAN SEUNG



Can the brain ever understand itself? According to some philosophers, we might eventually understand a fly's brain, but we're bound to fail with the human brain, because any entity can only be comprehended by an entity that is more complex. There is hope, though: the internet has intertwined our billions of brains with computers, and this human-machine hybrid may well be

sophisticated enough to understand the human brain. Next year we will see thousands, maybe millions, of "citizen neuroscientists" taking an important step in this direction. Astronomers have already crowdsourced space exploration to online amateurs, who have made exciting discoveries by viewing and classifying galaxies on a website called Galaxy Zoo. The most famous is Hanny's Voorwerp, a new type of object discovered by Hanny Van Arkel, a Dutch schoolteacher and Galaxy Zoo volunteer. What about the space inside our skulls? Using electron microscopes and high-tech slicers, neuroscientists can generate 3D views of the nervous system, through images that are sharp enough to show every

HIGH-SPEED SCIENCE

Scientists will be able to watch high-speed biological processes as they occur, thanks to a digital microscope, created by researchers at Leicester University, which can scan 100 frames per second. The device was developed by Nick Hartell of the university's Department of Cell Physiology and Pharmacology. He plans to use it to study cell mechanisms involved in the brain's storage of memories. The scanner uses mirrors that can be attached to existing optical microscopes.

