

parent craft and Philae to study the comet's interior. Not knowing the lander's exact location makes it much harder to process the data that scientists have already received and to generate accurate results, he says. Spotting the lander would also help to determine its exact location and angle, and to predict how likely it is to come back to life in the coming months as the comet nears the Sun and its solar panels begin to receive more light, Kofman says.

The decision is not an easy one, says Holger Sierks, who is principal investigator on Rosetta's OSIRIS (Optical, Spectroscopic, and Infrared Remote Imaging System) instrument.

The mission has already produced a haul of results, which were published in a series of papers in *Science* on 22 January (see *Nature* <http://doi.org/zpz; 2015>). Using data from OSIRIS and the Radio Science Investigation instrument, Sierks and his collaborators calculated the gravity on the rubber-duck-shaped comet and created a map (see 'Nearly weightless') that also takes into account the centrifugal force caused by the comet's rotation (H. Sierks *et al.* *Science* <http://doi.org/zp2; 2015>). The resulting force is greatest on top of the lobes, but it is about six times weaker in the neck region, where dust can lift off more easily. The team also used the data to calculate the comet's density, finding that the body is relatively fluffy and porous — with a density of around half that of water, giving clues to its structure and strength.

The researchers described three-metre-wide pebble-like features that are found all over the comet, which they nicknamed "goosebumps". Sierks says that the shapes could hint at the size of the grains of dust and ice that first clumped together in the early Solar System before forming larger bodies. "The hypothesis is these might be the building blocks of comets," he says.

In another of the papers, OSIRIS data enabled Sierks and his collaborators to classify the geography of the comet's surface on the basis of terrain types. These include fractures, possible impact craters and an array of dunes and ripples that may have been formed by gas travelling around the surface, like wind shaping sand in a desert (N. Thomas *et al.* *Science* <http://doi.org/zp3; 2015>).

The final word on whether to send Rosetta to look for Philae rests with ESA. Kofman says that an informal vote among Rosetta scientists came down narrowly on the side of doing it. As *Nature* went to press, the agency was thought to be leaning towards sticking to its original agenda, because looking for Philae would mean too much upheaval for the mission.

If ESA decides against a mission shift to hunt for Philae, the team could still get lucky: it may find clues as to the lander's whereabouts either in existing images or in new shots taken from flybys between 20 km and 50 km away in the coming months. Finding Philae in these kind of flybys is not impossible, says Accomazzo, "but it would be sheer luck". ■

## PSYCHOLOGY

# Clash over 'smart unconscious'

*Report examining decisions made while distracted adds to controversy about the power of the unconscious.*

BY ALISON ABBOTT

If you have to make a complex decision, will you do a better job if you absorb yourself in, say, a crossword puzzle instead of ruminating about your options? The idea that unconscious thought is sometimes more powerful than conscious thought is attractive, and echoes ideas popularized by books such as writer Malcolm Gladwell's best-selling *Blink*.

But within the scientific community, 'unconscious-thought advantage' (UTA) has been controversial. Now Dutch psychologists have carried out the most rigorous study yet of UTA — and find no evidence for it.

Their conclusion, published this week in *Judgement and Decision Making*, is based on a large experiment that they designed to provide the best chance of capturing the effect should it exist, along with a sophisticated statistical analysis of previously published data<sup>1</sup>.

The report adds to broader concerns about the quality of psychology studies and to an ongoing controversy about the extent to which unconscious thought in general can influence behaviour. "The bigger debate is about how clever our unconscious is," says cognitive psychologist David Shanks of University College London. "This carefully constructed paper makes a great contribution." Shanks published a review last year that questioned research claiming that various unconscious influences, including UTA, affect decision making<sup>2</sup>.

A typical study probing UTA asks subjects to make a complex decision, such as choosing a car or a computer, after either mulling over a list of the object's attributes or viewing the list quickly and then engaging in a distracting activity such as a word puzzle. However, such studies have drawn different conclusions, with about half of those published so far reporting a UTA effect and the other half finding none.

Proponents of the theory claim that the effect is exquisitely sensitive to experimental variations, and often attribute the negative results to the fact that many research groups varied elements of the set-up, such as the choice of puzzle used for the distraction<sup>3</sup>.

Critics say that the positive results came from having too few participants in the experiments.

Psychologists Mark Nieuwenstein and Hedderik van Rijn at the University of Groningen in the Netherlands set out with their colleagues to determine which explanation was correct.

They asked 399 participants — around ten times more than the typical (median) sample sizes in other studies — to choose between either 4 cars or 4 apartments on the basis of 12 desirable or undesirable features. They incorporated the full list of conditions that UTA proponents had reported as yielding the strongest effect, such as the exact type of puzzle used as a distraction. They found that

**"How we make decisions, and how we might make them better, has practical and intellectual importance."**

the distracted group was no more likely than the deliberating group to choose the most desirable item. The scientists then reanalysed 60 of the 81 experiments described in the 32 UTA papers published before April 2014. For this 'meta-analysis', they excluded experiments that had insufficient data for analysis or that deviated from conditions that are reported as likely to elicit UTA (only one of these experiments had claimed a UTA effect). They also included the results of their own study. When they applied a rigorous statistical meta-analysis, they found no significant UTA effect.

"Psychologists have historically prided themselves on their command of statistics," says psychologist Jonathan Baron at the University of Pennsylvania in Philadelphia, the editor of *Judgement and Decision Making*. But this study shows that many in the past were poorly designed. He adds: "If UTA is out there, it can't be captured in experiments designed in the lab."

Psychologist Ap Dijksterhuis at Radboud University in Nijmegen, the Netherlands, who first described<sup>4</sup> unconscious-thought theory, which predicts UTA, in 2004, says: "It is certainly true that psychology has ▶

improved quite a bit in recent years when it comes to analysing data. And yes, in the past, suboptimal analyses have been applied.” But he does not accept the findings of the meta-analysis. He says that it would have produced different conclusions if the researchers had included all previous UTA experiments, rather than excluding some and relying on a subset. He adds that “the evidence for UTA is growing quickly” and is widely accepted.

UTA is not the only ‘smart-unconscious’ claim to come under scrutiny. For example, experiments carried out under the “Many Labs” Replication Project, which coordinates labs internationally to repeat psychological studies in order to validate their claims, as well as several separate studies,

have challenged another psychological concept, social priming. Under social priming, certain behaviours are claimed to be modified unconsciously by previous exposure to stimuli, such as an American flag, or thinking about money<sup>5</sup>.

Other doubts raised about unconscious thought include its role in some types of decision making under uncertainty.

In spite of the most recent findings, Brian Nosek, a psychologist at the University of Virginia in Charlottesville who co-launched Many Labs, says that he remains optimistic about the theory underlying UTA. “I would be surprised if unconscious-thought theory did not hold up, because it fits with contemporary theories,” he says.

Shanks agrees that the debate over unconscious-thought theory is probably not over. “How we make decisions, and how we might make them better, has practical and intellectual importance,” he says. “If there is any evidence that distraction or unconscious rumination helped, we’d want to know about it — but the conclusions are so far very premature.” ■

1. Nieuwenstein, M. R. *et al. Judge. Decis. Making* **10**, 1–17 (2015).
2. Newell, B. R. & Shanks, D. R. *Behav. Brain Sci.* **37**, 1–19 (2014).
3. Strick, M. *et al. Social Cogn.* **29**, 738–762 (2011).
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## OCEANOGRAPHY

# US ocean sciences told to plot fresh course

Major report calls for cuts in infrastructure funding to increase spending on science.

BY ALEXANDRA WITZE

Faced with the rising costs of going to sea, the ocean-sciences division of the US National Science Foundation (NSF) should slash what it spends on marine hardware to fund more research, says a major report by the US National Research Council. It proposes making the biggest cut to the showcase US\$386-million Ocean Observatories Initiative (OOI), which after years of construction is just months away from being finished.

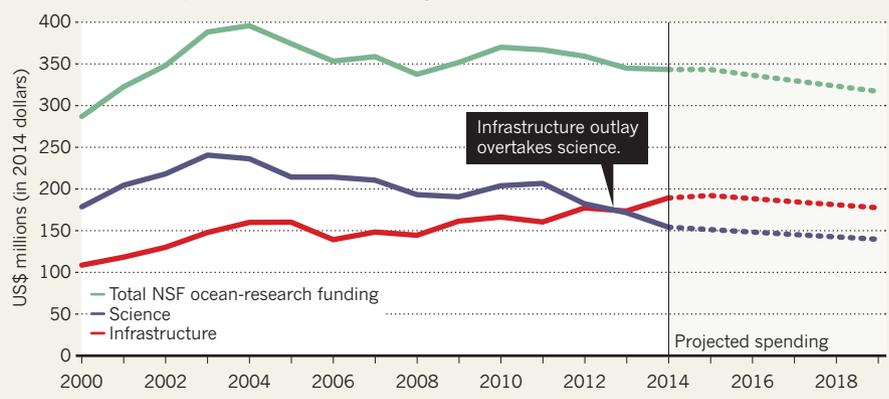
The report’s authors suggest that the NSF should cut 20% of the OOI’s operations budget, and reduce its contributions to the international scientific ocean-drilling programme and the US academic research fleet. If the agency takes that advice, it could free up enough money for US oceanographers to begin to reclaim much of their lost science, as well as expand partnerships with international researchers.

“It’s an exciting time to be in ocean science,” says Shirley Pomponi, an oceanographer at Florida Atlantic University in Fort Pierce and co-chair of the report committee. “But we need to take steps to make that better.”

US oceanography has been in trouble for a while. The US Navy paid for the bulk of the country’s academic oceanographic work until the 1960s, after which the NSF began shouldering more of the burden. But even as filmmaker James Cameron, flush with private money, explored the Pacific Ocean’s Mariana

## SINKING SCIENCE

As the US National Science Foundation (NSF) has increased its spending on ocean hardware, such as ships and instruments, its funding for ocean science has fallen.



SOURCE: NRC

Trench with a handful of scientists in 2012, most research oceanographers found themselves with fewer ways to get to sea.

## EIGHT PRIORITIES

Over the past decade, the NSF’s ocean-infrastructure expenses have risen by 18% — even as the ocean-science division’s inflation-adjusted budget dropped by more than 10%, to just under \$350 million annually. In 2013, the division started to spend more on infrastructure than it did on science (see ‘Sinking science’). That is when the NSF asked for outside advice on how to cope.

The report, which was published on 23 January, lays out eight science priorities for the next decade, including studies of sea-level change, marine biodiversity, earthquakes and tsunamis, and life beneath the sea floor. Unusually, it also suggests how to pay for the studies — an immediate 10% cut in infrastructure, spread unequally among three programmes, followed by a similar or larger cut over the next five to ten years. “This document gives them the flexibility to make some really hard decisions,” says Samantha Joye, an oceanographer at the University of Georgia in Athens.

The smallest suggested cut, just 5%, applies