

A little knowledge

The significance of expertise passed on by direct contact— tacit knowledge — is moot.

08 October 2014

For the last two decades of the twentieth century, a cold war rumbled on between the laboratories of physicists in Moscow and in the West over the quality of sapphire. The Russian scientists claimed to have measured the rate of decay of the material's resonance — a signal of its quality — with what researchers elsewhere considered impossible precision. The stakes were high: sapphire mirrors were being considered for use in a new generation of laser interferometer gravitational-wave detectors. But were they up to the task? Labs in the United States and United Kingdom could not reproduce the Moscow findings. The discrepancy fuelled mistrust and antagonism.

At the turn of the millennium, the mystery was solved. Measuring the quality of sapphire, it turns out, is as much art as science. The Moscow scientists were expert experimenters, but this expertise was not transferred through the methods sections of their academic papers. The fine fibres used to suspend the sapphire cylinders under investigation were greased with “the presence of a fatty film”, one of their translated papers pointed out. Less explicit was the source of the grease. Only after years of struggling with various lubricants did the Western researchers realize that one member of the Russian group would sometimes run the thread across the bridge of his nose or behind his ear. With the right amount of human ‘flossing’ (and the right human), the Western scientists managed to get similar results.

The thread greasing is an example of tacit knowledge: know-how that can be passed on only through direct contact, and not by written or verbal instruction. How to ride a bicycle is a classic case. How to make an atomic bomb is a less-well-known example: all the instructions to build a nuclear weapon may be there on the Internet, but the ‘been there, done that’ personal experience is not. Indeed, security analysts have suggested that the lack of active testing and consequent erosion of nuclear-weapon tacit knowledge is leading to the “uninvention” of the bomb, and reduced credibility of the nuclear deterrent.

In a paper published this month in the journal *Science and Public Policy*, researchers in the United Kingdom suggest that a reverse process is under way when it comes to biology and biological weapons (J. Revill and C. Jefferson *Sci. Public Policy* **41**, 597–610; 2014). Access to tacit knowledge in the life sciences is not dwindling but proliferating, argue James Revill and Catherine Jefferson. As secrets are shared, chiefly through advances in information and communications technology, tacit knowledge becomes explicit and barriers are demolished. And it is worth considering, they point out, what those barriers have held back. Many attempts have been made to manufacture deadly ricin, for example, probably based on Internet recipes, but most fail to truly weaponize the material by not milling it to the necessary particle size.

“Knowledge has never been more fluid — a good thing, science traditionally argues.”

“Even where optimised weaponisation is not the strategic goal,” the authors write, “tacit knowledge may be an important limiting factor in the ability of unskilled actors to exploit advances in [science and technology], which has important implications for the way in which threat is assessed.” Policy-makers who try to proscribe the development of biological weapons should first gain a better idea of what is scientifically possible and what is not, they suggest, and a sense of how that is changing.

What has any of this to do with the work of a regular bench scientist? Quite a lot, actually. As more attention is paid to the ‘reproducibility crisis’ in science, and journals and funders wrestle with how to make published research findings more robust, tacit knowledge has emerged as both a problem and an opportunity.

In a Comment piece in this journal last year (M. Bissell *Nature* **503**, 333–334; 2013), Mina Bissell warned that the push to replicate findings could unfairly malign research (and researchers) that — just like measuring sapphire quality — relies on tacit-knowledge techniques that are better learnt than studied. The *Journal of Visualized Experiments* already aims to narrow the gap between tacit and explicit knowledge by requiring scientists to video their techniques, and so show colleagues how to conduct procedures, rather than simply telling them.

There are known unknowns and unknown unknowns, as former US defence secretary Donald Rumsfeld clumsily explained. Some tacit knowledge is deliberately withheld, and some journal methods sections offer insufficient space for elaboration. Those are the known unknowns and are most easily addressed. The tacit knowledge that is harder to pass on is the nugget of information that neither the teacher nor the pupil realized was important: the varnish on the Stradivarius violin; the greasing of the thread behind the ear.

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The trend in science is towards greater openness and data sharing. Communication is instant and in real time; knowledge has never been more fluid. Science traditionally argues that this is a good thing. There is no inherently good or bad technology, goes the mantra, only good and bad applications. Is the same true for all forms of knowledge? One way or another, we could be poised to find out.

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Robert Robert • 2014-10-11 03:39 AM

The tacit knowledge should be showed by current information technology, especially the video tech. So the rest of researcher can clearly see the operation like in the original testing site.



Moshe Pritsker • 2014-10-09 02:43 PM

Obviously, filming and publication of experiments on video provide an efficient way to transfer tacit knowledge in science. In video, one can see how each step in experiment is performed and avoid most of the reproducibility problems. Disclosure: I am the publisher of JoVE, the science video journal (jove.com)



Mir Shahram Safari • 2014-10-09 07:48 AM

I think tacit knowledge could be explicit knowledge just by faithfully describing some important tips that are absolutely necessary for obtaining similar results, It could be publish in online version of article as a supplement. In Persian, we have an aphorism that sometimes tacit knowledge is more important than explicit knowledge: "pottery blowing" or فوت کوزه گری.



Ronald Schleyer • 2014-10-09 03:38 AM

What is so "clumsy" about pointing out the often missed distinction between known unknowns and unknown unknowns? One is a headache and the other can kill you. Rumsfeld, a master of death, was only invoking one of his mantras.



Fernando Santiago • 2014-10-08 05:44 PM

The lack of transmission of "tacit" information in the laboratory seems to be one of the chief arguments employed by the STAP cell proponents. If important scientific discoveries are reproducible in the hands of a handful of researchers and not the rest of the scientific community, perhaps something of an "open house" method should be encouraged, whereby peers can sit benchside.

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