



50 Years Ago

'The future of nuclear power' — The advanced type of gas-cooled reactor was expected in 1964 to cost less than a coal station of the same date, and within a year of the delivery of this Lecture the firm tender prices for the Dungeness B nuclear station showed that this was, in fact, the case, provided the station is built at the tender price. In the United States similar dramatic falls in costs have been experienced with their water moderated reactors; and Canada's heavy-water reactor is expected to have very low fuel costs, although it will have a high capital cost. These types of reactors, by the end of the century, would be using 100,000 tons of uranium per annum, on reasonable assumptions as to the rate of development of nuclear stations.

From *Nature* 19 February 1966

100 Years Ago

The memorandum regarding the neglect of science to which you refer in your leading article last week fails in my judgment by its moderation. The proposal that at least as many marks in the Civil Service examinations shall be allotted to science as to classics, may be a step in the right direction, but it is a halting one ... The revelations that have come to light in the course of this bloody war will, we hope, do at least this good, that the people may be induced to appreciate the necessity of basing education upon natural science instead of upon the classics. The appointment of a Minister of Science which is advocated in the memorandum would under existing conditions be of little use. Whatever qualifications he might be selected for, we may safely prophesy that entire ignorance of the subject he is to administer would be one.

From *Nature* 17 February 1916

the thriving new field of evolutionary religious studies, researchers are drawing on evolutionary theory to explore how religious beliefs can bring adaptive advantages — that is, contribute to an individual's survival or reproductive success. Although major debates remain², one theory that has gathered momentum is that a belief in supernatural punishment for violating social norms may be adaptive³ (Fig. 1).

How could this idea apply to cooperation? Deterring oneself from the pursuit of self-interest because of the risk of punishment from a watchful supernatural eye would seem to reduce an individual's evolutionary fitness, and should thus be eliminated by natural selection. However, even if such beliefs are false and costly, they may have generated net benefits: to individuals, by steering them away from selfish behaviour that risked retaliation in increasingly transparent and gossiping human societies; and/or to groups, by increasing the performance of the group as a whole in competition with other groups^{4,5}.

But what evidence do we have for such a theory? Empirical evidence that supernatural beliefs promote cooperation is mounting, but has tended to rely on qualitative, society-level or proxy measures of beliefs. Study participants have also typically been university students in developed nations, thus omitting the small-scale societies most relevant to the evolutionary problem at hand: how human groups achieved cooperation and made the transition from small to large societies in the first place. Perhaps the most important lacuna is that previous studies have not rigorously addressed whether the beliefs of the recipients of cooperative acts changes people's generosity towards them.

Purzycki and colleagues' study addresses many of these issues by using controlled experimental games among participants from eight small-scale societies around the world and tying the results to explicit measures of individuals' beliefs. Participants played a simple but clever game (designed to subtly reveal preferences), in which they allocated coins between a distant co-religionist (people who were members of the same religion, but who lived geographically far away) and either themselves or a local co-religionist. The researchers found that the more subjects rated their god as moralistic, knowledgeable and punishing, the more money they gave to distant strangers adhering to the same religion. Notably, belief in rewards from the god could not account for the results — supernatural punishment seemed responsible.

Because the study is correlational, one worry is that some unexamined variable could account for the results — perhaps certain people are disposed to both kindness to strangers and belief in punitive gods, for example. However, Purzycki *et al.* show that allocations increased for moralistic gods that were punishing and knowledgeable, but not

for more locally relevant supernatural agents that were also punishing and knowledgeable. Hence, general conceptions of supernatural agents cannot alone explain the results. Rather, it is moralistic, 'big' gods that seem to stimulate generosity towards distant co-religionists⁶.

The authors did not conduct experiments to assess allocations to oneself versus a local co-religionist, nor experiments involving non-religious recipients, so we don't know whether local supernatural agents might promote cooperation between individuals within the local community, as other work has found⁷, or whether any kind of god promotes cooperation with strangers of another, or no, religion. Purzycki *et al.* focused on cooperation with co-religionists beyond the local community, and thus the expansion of human society from small to large groups. But future studies of the role of local gods are needed to improve our understanding of the evolutionary origins of religion (before there were big groups or big gods), and of whether and how religion brings adaptive advantages to individuals⁸.

It is worth emphasizing that the subjects in this experiment were not cooperative with random strangers, only with strangers that shared the same god. We therefore still face the challenge of understanding the promotion of cooperation and trust among members of different religions. Purzycki and colleagues' finding that sharing the same god is key to cooperation suggests that this may be an even harder nut to crack. In fact, one of the most compelling explanations for why individuals may help the group at their own expense is that it aids survival in an environment of inter-group competition. Whenever the threat of exploitation or warfare is present, the best protection is larger and more-cohesive societies, which are better able to deter or defeat rivals. Religion's positive role in reducing self-interest and promoting cooperation may therefore reflect the costs of competition as much as the benefits of generosity⁹.

Religion is arguably the most powerful mechanism that societies have found to bind people together in common purpose. From ancient civilizations, to the spread of Christianity, to today's Islamist terrorist groups, religion has motivated not only the subordination of self-interest for the wider group, but even martyrdom in the name of a god. We are still grappling to understand, from a scientific perspective, why and under what circumstances humans sacrifice their own welfare for the benefit of distant others¹⁰. But there is little doubt about the power of religion to promote allegiance to one's god and group. Purzycki and colleagues' study offers the most explicit evidence yet that belief in supernatural punishment has been instrumental in boosting cooperation in human societies. A large part of the success of human civilizations may have lain in the hands of the gods, whether or not they are real. ■