Unbelievable Results Spark a Controversy

A paper whose experimental results seem to have no physical explanation could encourage the practice of homeopathy

THE DECISION by the British journal *Nature* to publish what it acknowledges are "unbelievable" results has generated a good deal of publicity and raised a few eyebrows in the scientific community. *Nature* says it kept the paper for 2 years while having its results repeated in independent laboratories, and finally decided to publish it partly because word of the experiment had leaked to the popular press. Adding to the controversy is the fact that the results are widely seen as providing evidence for homeopathic medicine, a practice that is popular in France and that advocates using vanishingly small doses of various substances to cure disease.

The unbelievable research result stemmed from an immunological experiment to test how much one can dilute solutions of antibodies and still evoke a reaction from a certain type of white blood cells. A team of researchers led by Jacques Benveniste of the University of Paris-Sud studied the response of human polymorphonuclear basophils, a type of white blood cell, to varying concentrations of antibodies to immunoglobulin E in distilled water. When the basophils are exposed to the antibodies, they release histamine and change their staining properties. This allows the researchers to test for antibody response by staining the blood cells.

As reported in the 30 June issue of *Nature*, the researchers started with a standard concentration of the antibodies in water and began diluting it in stages—by factors of 10 in some experiments and factors of 100 in others. They repeated the dilutions 60 times, measuring the basophils' response to the solution after each step. After 20 of the tenfold dilutions, the solution would be diluted by a factor of 10^{20}, and the probability that even a single antibody molecule remained should be quite small. The solution should have evoked no response from the white blood cells.

But the researchers saw a response. As many as 40 to 60% of the basophils continued to react to the solutions, even at dilutions up to 10^{120}. Even more surprising, they found that the response varied periodically as they decreased the concentration—the percentage of basophils reacting to the solution would decline for several successive dilutions, then it would increase for the next several dilutions. This behavior continued throughout the entire series of 60 dilutions.

Benveniste originally submitted these results to *Nature* 2 years ago. At *Nature*'s insistence, he had the experiments repeated at independent laboratories in Israel, Italy, and Canada. All three labs were able to reproduce the results using Benveniste's staining technique, which Benveniste said was vital to detecting the reaction. "If you stain it very hard, you are not going to see the result," he explained.

The explanation that Benveniste suggests for his surprising result is that the antibodies somehow leave their imprint on the water molecules, and it is this imprint, not the presence of antibodies, that causes the response in the extremely dilute solutions. He notes it is necessary to agitate the solution vigorously after each dilution to obtain a response and suggests this agitation may be necessary for "inducing a submolecular organization of water."

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Nature, for its part, rejects these imprints as "ghosts." "There is no objective explanation for these observations," said an editorial accompanying the paper, but it was published because referees could find no flaws with the experimental procedure and the results were repeated in several independent labs.

Although Benveniste's results are controversial enough by themselves, the controversy is magnified by their connections with homeopathic medicine. Practitioners of homeopathy give vanishingly small doses of certain substances to their patients, in the belief that a substance that causes certain symptoms when taken in normal doses will cure a person suffering those symptoms when taken in very small doses. Because Benveniste's paper seems to imply that such small doses can evoke a physiological response, it has received a great deal of attention in Europe, particularly France.

Benveniste said he performed his experiments as a test of homeopathic medicine, responding to a challenge given to him by a believer in homeopathy. Two of the researchers on his team were homeopathic doctors, he said, but he himself is "totally foreign to homeopathy."

Among the researchers contacted by *Science*, reaction to the paper ranged from skepticism to downright disbelief. One prominent scientist had pointedly not read the paper, believing it would be a waste of his time. Others suggested the results reflect an experimental artifact rather than an actual physical occurrence. Even Benveniste seemed ready to accept that the results are an artifact, providing someone could point out what causes them. "We are all ready to see a good explanation for these surprising results," he said.

Many scientists questioned *Nature*'s decision to publish the results when it did, instead of waiting to complete an "investigation of the circumstances in which the experiment was carried out." *Nature* has announced it will publish the results of such an investigation in its 28 July issue. Benveniste said a group of investigators watched repetitions of the experiment and left his lab with 1500 photocopied pages of lab books. Benveniste said he agreed not to reveal the investigation's results ahead of time, but noted that the investigators watched only one of a series of many experiments and that if this one experiment turned out differently than the others, its results would still have to be balanced against all the rest.

The editor of *Nature*, John Maddox, said he published the paper before the investigation was complete because the French press was already reporting Benveniste's results. He noted the magazine has twice before published unbelievable results; in both cases the paper was balanced by accompanying remarks by referees.

In 1972, the magazine published a paper claiming the isolation, identification, and synthesis of a compound produced in the brains of rats that were trained to avoid the dark and that supposedly caused untrained rats to learn dark avoidance more quickly. In the same issue, *Nature* published an attack on the paper by one of its referees, an attack that was twice as long as the paper itself. In 1974, the magazine published the results of experiments suggesting certain paranormal abilities in some humans, notably Uri Geller, and accompanied the paper with an editorial explaining the reservations of the paper's referees. ■ ROBERT POOL