

## **It's All Positive**

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Taken as a whole, the research literature is dishonest. At the very least, it can be considered somewhat misleading. That is because negative results are usually not publishable. Those of us who conduct research and publish the results know that our experiments hardly ever work the first time. There are protocol adjustments to make, temperatures to control, additional measurements to make, timing issues, calibration problems, and a host of other reasons why failures occur. Biological experiments are often much more sensitive to specific conditions than are other kinds. Enzymes require optimal conditions to be effective, biochemicals degrade with time, target cells adapt to new environments, and temperature fluctuations may have profound effects. There are so many reasons why an experiment may not have the expected results that extreme care is usually required to be successful. Sometimes they also take trial-and-error, or even luck, to succeed.

Those who read the literature can easily be misled. After all, the papers they read overwhelmingly describe successful outcomes. Very often, the unsuccessful trials that led to successful outcomes are not mentioned. Sensitive conditions for success are not usually emphasized, even if mentioned at all. If one were to try to replicate an experiment, the best thing to do is to contact the experimenter to find out details of what actually was done. Otherwise, the path to a successful outcome could become very tortuous. All this is almost never written in a published paper.

A case in point is a paper that I just published giving the results of visualization of flow pathways of leakages into respiratory protective masks. I had included in the paper the means we had used to generate visible particulate smoke to see the paths taken by the smoke between the leakage sites and the mouth during inhalation. The more twisted the pathway, the longer it would take for the wearer to inhale potentially contaminated air, and the more protection would be afforded by the mask.

This was not the first method to generate smoke that we tried. We had actually tried three or four other methods first. In order to let others know of our prior unsuccessful methods, I had included a short paragraph describing those other methods. One of the reviewers thought that it was useless to include this extra information, and that the paragraph should be eliminated. Without that paragraph, others who tried to conduct similar experiments might use our successful method first, but might not, because the successful method was more expensive than some of the unsuccessful alternatives. Retaining that paragraph might have helped others to avoid the same mistakes we had made. I insisted, and the paragraph was retained, but it could just as easily been eliminated.

It is easy to publish positive results, but difficult to publish negative results. Not all failures can be useful, but sometimes negative information can be positive.