

Huff and puff

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Abstract

Freelance journalist Darrell Huff rose to prominence with his book *How to Lie with Statistics*. But its sequel—a statistical counterattack to public health fears about tobacco—never made it to print. **Alex Reinhart** recounts the untold story.

IN 1954, FREELANCE JOURNALIST Darrell Huff wrote possibly the most popular book on statistics ever published: *How to Lie with Statistics*, a humorous illustrated guide to misleading plots, biased surveys, and meaningless numbers. Intended to help the layman defend against the guile of marketers and politicians, it was swiftly adopted in college classes and has been in print ever since. Though he had no formal training, Huff's clear writing and amusing anecdotes made him a public figure in statistics.

Less well-known is Huff's sequel, *How to Lie with Smoking Statistics*, which earned him roughly \$10,000—more than \$70,000 in 2014 dollars—despite being abruptly canceled before ever entering print. It was an artifact of the 1960s debates on the health effects of tobacco, funded and edited by tobacco companies to serve as their counterattack to the Surgeon General's 1964 *Smoking and Health* report and the ensuing public health frenzy. With Huff's well-respected name attached, it promised to be a potent weapon, selling a projected 100,000 copies, and yet the project mysteriously died at the end of 1968.

The ethics of Huff's involvement in the tobacco industry's defense have already been examined,² but the full story has never been told. Why did such a potent pro-smoking weapon, a pioneering attempt to use statistical arguments to undermine undesirable science, never reach print? The story starts in the early 1960s, when anti-smoking momentum began to build.

THE TOBACCO DEFENSE

The Surgeon General's report was certainly not the first to suggest that smoking could cause cancer and lung disease, being preceded by a Royal College

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of Physicians report among others, but it was the most influential. Combining animal and epidemiological studies, it reached the strong conclusion that “cigarette smoking contributes substantially to mortality” and sparked numerous Congressional hearings on tobacco regulation, leading Congress to pass the Cigarette Labeling and Advertising Act of 1965, which required cigarette packages be labeled with “Caution: Cigarette Smoking May Be Hazardous to your Health.”

This was actually a victory for the tobacco companies: the Federal Trade Commission had originally proposed a much stronger warning to appear on cigarette packages and all cigarette advertising, which Congress promptly overruled with the weaker version while stripping the FTC and the states of their power to regulate cigarette commercials on television. But this clause was due to expire on July 1, 1969.⁵

The tobacco industry had to quickly organize a defense against regulation and lawsuits, or their market could collapse. Much of this work was organized by the Tobacco Institute, a multi-company collaboration which designed public relations and defensive strategies. Their arguments rested on two seemingly contradictory claims:

- Everyone has heard that smoking is harmful, so there is no need for health warnings or regulation. Smokers can make their own informed decisions.
- There is absolutely no scientific evidence that smoking is harmful, so there is no need to stop selling cigarettes.⁴

The first point was supported by industry-funded opinion polls showing that most of the smoking public had heard the claims that smoking causes cancer, though the industry did not ask whether the public *believed* the claims. But their largest effort was focused on the second point, at proving that the Surgeon General’s claims were founded on poor statistics—and at proving that a “merely statistical” report could not prove a causal relationship.

To that end, Darrell Huff was hired in 1964 to write a short pamphlet, tentatively titled “The Holes in the Case Against Smoking,” both for distribution to key Congressional committees and to tobacco industry lawyers to inform their defenses. By 1965 he had delivered his testimony to the Senate Committee on Commerce, identifying “eight major warning signals” in the Surgeon General’s report.

This testimony was apparently a success, since Huff was soon expanding the pamphlet into a book with the catchier title *How to Lie with Smoking Statistics*. He worked in correspondence with Edwin Jacob, a lawyer hired by the industry to coordinate Congressional testimony and legal defense. Jacob made comments on Huff’s proposed outline and guided his choice of topics to meet the industry’s needs, while funding Huff’s work out of a special industry account. By 1968, the book was picked up by Macmillan, which planned to

print 100,000 paperback copies with marketing support from the Tobacco Institute.

The manuscript, and the story surrounding it, only became available after the 1998 Tobacco Master Settlement Agreement, which made publicly available tens of millions of pages of correspondence and reports which had been uncovered during lawsuits against the tobacco industry. These are now available online through the Legacy Tobacco Documents Library, which includes letters between Huff and various industry lawyers and consultants, along with the complete manuscript of the book.*

BLOWING SMOKE

Huff's final draft expanded his "eight major warning signals" to eleven chapters, covering problems such as sampling bias, inadequate sample sizes, confounding variables, misleading graphics, and misread medical records. The Surgeon General's argument was attacked from several angles: the epidemiological studies drew from small and biased samples while reporting their results with misleading precision and confusing graphics. The massive increase in cancer-related deaths could be attributed to growing populations, reductions in other causes of death, and improved medical diagnosis and reporting. The only controlled experiments used animals, which may not respond to tobacco smoke in the same way as humans do.

Huff apparently recognized that the case against smoking wasn't based on a single definitive randomized trial. It was based on the combination of hundreds of separate studies and experiments, each contributing small pieces to the anti-smoking argument. So he didn't need to attack the strong and cohesive whole; he merely needed an army of niggling statistical doubts to undermine individual studies. These doubts were supplied by an overwhelming mass of anecdotes and examples, only a few of which related to tobacco.

To illustrate the possibility that better medical reporting is responsible for rising lung cancer rates, for example, he claims that breast cancer rates were once higher among Chinese men than among Chinese women—because women were too reluctant to go to the hospital. To prove that higher cancer rates among smokers can be explained away with convenient confounding variables, he cites "a positive correlation between the number of storks' nests found on Danish or Dutch houses and the number of children born in those houses," which of course is a result of larger families living in larger houses with more nesting space, rather than stork-based baby delivery.

The irreverence of these examples, which he also used in testimony before the Senate Committee on Commerce, provoked Senator Maurine Neuberger to ask "Do you honestly think there is as casual a relationship between

*Links to key documents, and the entire manuscript, are available at <http://www.refsmmat.com/articles/smoking-statistics.html>.

statistics linking smoking with disease as there is about storks and Chinese and so on?” They “seem to me the same,” Huff replied, and there is no reason to doubt him—he thrived on such anecdotes.

To complement the stork story, Huff’s manuscript gave examples of confounding factors that could explain the association between smoking and cancer. Confounding was a popular theme for pro-smoking arguments; as the Mayo Clinic statistician Joseph Berkson so eloquently put it in a 1958 article in the *Journal of the American Statistical Association*,

If 85 to 95 per cent of a population are smokers, then the small minority who are not smokers would appear, on the face of it, to be of some special type of constitution. It is not implausible that they should be on the average relatively longevous, and this implies that death rates generally in this segment of the population will be relatively low. After all, the small group of persons who successfully resist the incessantly applied blandishments and reflex conditioning of the cigaret advertisers are a hardy lot, and, if they can withstand these assaults, they should have relatively little difficulty in fending off tuberculosis or even cancer!¹

Other explanations, such as that proposed by R.A. Fisher, argued by analogy: smokers often light a cigarette in response to “a slight cause of irritation—a single disappointment, an unexpected delay, some sort of mild rebuff,” using the cigarette to soothe their frustration. And so, “anyone suffering from a chronic inflammation in part of the body”—such as a precancerous lung—might be inclined to smoke more frequently. Huff quoted Fisher’s argument extensively in his chapter on “genotypes,” alongside claims that smokers differ from nonsmokers in many personality and physical traits. These systematic differences, he said, prevented any statistical analysis from proving a causal relationship.

Other chapters make less cohesive points. In Chapter 11, titled “From Figures into Words,” he discusses the dangers of misinterpreting figures to reach unsupported conclusions. His examples vary from the number of books read by the average Italian each year to the difference between calculation of interest on savings and loans, the difference between percents and percentage points, the number of children’s books written yearly, the optimal age to teach children to read, the correct interpretation of life expectancy figures, and the inherent difficulty in comparing Soviet and American wages and costs of living, all crammed in 22 typewritten pages. Only a few cigarette-related examples appear; for example, Huff quotes an article which points out that “Canada, with the second highest cigarette consumption, has the lowest lung-cancer death rate; while Austria combines the second-highest mortality from the disease with the lowest cigarette usage.” It’s not clear what this has to do with the thesis of the chapter, but Huff fits it in nonetheless.

Argument by anecdote had its drawbacks. Many examples merely repeated points made in earlier examples and in *How to Lie with Statistics*, and the needless repetition caused one Institute consultant to worry that “this mass of verbiage needs drastic editing before it will directly address itself to the needs of our industry.” “Mass of verbiage” seems an apt description, though Huff’s breezy style makes the tedium tolerable, and the anecdotes would have fueled many water-cooler arguments about smoking. If modern social media had existed in the late 1960s, his stories would have been taken out of context and shared endlessly on Facebook by angry smokers.

STATISTICAL ERROR

But remember that Huff was a journalist, not a statistician, and so he gets into the most trouble in his sections on the interpretations of statistics. Huff attempts to explain the principles of significance testing in chapter 2, on “Sample Size and Significance.” He presents the example of a medical trial: if a certain disease is known to have a 50% death rate, but six out of six patients survive when given a new drug, can you be sure the success was due to the treatment and not just good luck?

A mathematical law tells us that the probability of a series of successes is found by multiplying together the probability of each. Without treatment you had half a chance with each patient. Multiply together those six one-half chances and you will get a product of one sixty-fourth. There was, then, one chance in sixty-four that luck would produce so good a result. You can conclude the odds are 63 to one that the treatment really has value.

The first three sentences are an accurate description of the calculation of a p value, but the last sentence is an example of perhaps the most fundamental error in statistics: the fallacy of the transposed conditional. The probability of one sixty-fourth is the probability of obtaining this result *while assuming the treatment has no value*; it cannot be the probability the treatment has no value. A hypothesis test cannot give the probability that Huff desires—only Bayes’ rule can, with a suitable prior belief.

Another chapter, titled “Overprecise and Unknowable Figures,” rightly attacks figures presented without a confidence interval or any indication of uncertainty. For example, the Surgeon General’s report mentions a “mortality ratio of 1.20”—indicating that a certain group of smokers dies at 1.20 times the rate of non-smokers—which is “statistically significant at the 5 percent level.” Huff agrees that expressing the result as a mortality ratio is perfectly proper, but

It does have an unfortunate result: it makes it appear that we now know the actual mortality ratio of two kinds of groups right

down to a decimal place... From the accompanying statement of significance (“5 percent level”) we discover that all that is actually known is that the odds are 19 to one that the second group truly does have a higher death rate than the first.

The first sentence is fair criticism, but the second again shows Huff’s misunderstanding of statistical significance. “Statistically significant at the 5 percent level,” corresponding to $p < 0.05$, does not give the odds Huff claims it to. In this case, significance means that *assuming that the mortality ratio is 1*, there is less than a 5% chance of obtaining data equal to or more extreme than what the study obtained. Huff inverted this, obtaining an easily-interpreted but also entirely misinterpreted result. He consistently repeated the error in several other chapters where statistical significance appears, showing this was not simply a mistake in wording.

But this is not too surprising: surveys have found that many statistics students and practicing scientists hold the same misinterpretation of significance tests. More worrisome is the result of a technical review of the manuscript by University of Chicago statistics professor K.A. Brownlee, who read this comment and several others like it and apparently didn’t notice the error, saying that “the manuscript is of an intellectual standard to be a credit to Macmillan.” (He did, however, “correct” one case where Huff gave the odds as 20 to one instead of 19 to one.)

Brownlee had been recommended to Macmillan by University of Rochester president W. Allen Wallis, who said that finding a truly impartial reviewer would be difficult. Instead, he suggested having the book read first by a pro-smoking statistician: “If he should say not to publish the book, I think you can be certain that it is not publishable.” He believed that Brownlee, being “one of those who is convinced that the evidence does not prove that smoking causes cancer,” would be suitable. The industry had noticed as well: Brownlee had already been hired as a paid consultant.

SNUFFED OUT

Macmillan and Huff spent most of 1968 in protracted contract negotiations after Macmillan proposed printing 100,000 paperback copies. Huff rejected their initial offers on the grounds that a hardcover edition would lend the book more prestige, and suggested a more favorable royalty arrangement with a guaranteed minimum printing run and higher rates. He did not mention that he had already been paid for his work by the tobacco industry.

Negotiations continued, and the Tobacco Institute became anxious. It wanted to advertise the book and purchase copies for its own use, and so eventually its public relations consultancy, the Tiderock Corporation, interceded on Huff’s behalf, and by September 1968 an agreement had been reached for a hardcover edition followed by 100,000 paperback copies. Huff would make

some necessary revisions to the book so that Macmillan could go to press “in eight to 10 weeks,” though further negotiations delayed the process. Macmillan was ready to mail a final contract in November when the project abruptly collapsed.

The trouble had started brewing in the spring of 1968, when the Tiderock Corporation was caught in an embarrassing trick: allegedly independent pro-smoking articles in *True* and the *National Enquirer* were underwritten by the industry and then anonymously mailed to key lawmakers and public figures, resulting in a public backlash and a Federal Trade Commission investigation.

To prevent a repeat of this disaster, industry lawyers suggested a disclaimer to be placed in the preface of Huff’s manuscript disclosing the tobacco industry’s involvement:

The original investigations by the author of the statistical materials relating to smoking and health were made possible by a grant from the tobacco industry. The discussion and conclusions are solely those of the author.

This was an understatement: Huff had developed his material in collaboration with Edwin Jacob and Tiderock, beginning with his paid Senate testimony and continuing as he completed the book. The Tobacco Institute only funded Huff with the understanding that final publication would be their decision. But even partial disclosure would prevent another scandal about undisclosed industry support, so industry representatives wrote to Macmillan in July admitting that Huff had given paid testimony and suggesting that the book include an acknowledgment of Huff’s “not really extensive” ties to the industry. Macmillan, though surprised to hear that Huff had any involvement with the industry beyond a grant to write the manuscript, evidently agreed.

The Tobacco Institute also sought legal advice on its plan to support and advertise Huff’s book. While authors have a First Amendment right to make false or misleading claims in their books (unless they cross the line into fraud), the Institute could not legally use false claims to advertise tobacco products. If Huff made any errors, the Federal Trade Commission could decide that their promotion of *How to Lie with Smoking Statistics* constituted an advertising campaign for tobacco and charge the Institute with false advertising.

The lawyers considered their options. A First Amendment defense was certainly possible, but risky, and a legal battle would bring unpleasant media attention regardless of its outcome. But they seemed confident in Huff’s work, and planning continued throughout the summer.

The Tobacco Institute, however, was not confident in Tiderock.³ After the *True* fiasco it began building up its own public-relations staff and reducing its dependence on consultants and contractors. Tiderock soon ceased work for the Institute, and Huff was told to correspond with the Institute directly.

But no such correspondence appears in the Legacy Tobacco Documents Library. Huff simply vanishes after 1968, apart from accounting statements detailing the money he was paid for further Congressional testimony. If any record exists of the end of *How to Lie with Smoking Statistics*, it never found its way to the Library.

WHAT HAPPENED?

There are many possible explanations for the sudden demise of Huff's book. The industry realized in 1968 that it had a credibility problem: the public was unlikely to trust a book funded and promoted by the Tobacco Institute. Perhaps the campaign was shelved after Tiderock closed up shop. Perhaps it was too late—some tobacco regulations had already been passed, others were inevitable, and new tactics were needed. Or perhaps the thought of legal trouble made them retract their offer to advertise the book, making Macmillan kill the project.

But Macmillan was on the brink of signing a contract with Huff. Did they have second thoughts, or was Huff told to kill the project? Or were the Tiderock consultants correct in their assessment that “this mass of verbiage needs drastic editing” and was unpublishable without serious revision?

The Documents Library offers no clues. Only documents produced or received by the industry are included, so any correspondence between Huff and Macmillan may not appear. Andrew Gelman, professor of statistics at Columbia University, reviewed the ethics of Huff's involvement with the industry and suggested Huff could have intentionally killed the project to save his own reputation, which would have been destroyed by his association with tobacco.² But just a few months before the book's demise he had been fighting for a prestigious hardcover and better royalties.

Whatever the reasons, *How to Lie with Smoking Statistics* went unpublished, protecting its better-known sibling *How to Lie with Statistics* from guilt by association.

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