

Typing Errors

The standard typewriter keyboard is Exhibit A in the hottest new case against markets. But the evidence has been cooked.

[Stan Liebowitz](#) and [Stephen E. Margolis](#) | June 1996 [Print Edition](#)

Like a modern horror movie villain who keeps coming back from the dead, a false story can take on a life of its own: Eskimos have hundreds of words for snow, Millard Fillmore ordered the first bathtub for the White House, that sort of thing. Even after they are shown to be false, some stories are repeated, embellished, and occasionally built into entire belief systems. These fictions may ordinarily be little more than curiosities or mere affronts to our concern for the truth. But our concern here is with one such story that is put forward as part of a case against the effectiveness of free markets and individual choice. This story has consequences.

Our story concerns the history of the standard typewriter keyboard, commonly known as QWERTY, and its more recent rival, the Dvorak keyboard. Pick up the February 19 edition of Newsweek and there is Steve Wozniak, the engineering wunderkind largely responsible for Apple's early success, explaining that Apple's recent failures were just another example of a better product losing out to an inferior alternative: "Like the Dvorak keyboard, Apple's superior operating system lost the market-share war." Ignoring for the moment the fact that just about all computer users now use sleek graphical operating systems much like the Mac's graphical interface (itself taken from Xerox), Wozniak cannot be blamed for repeating the keyboard story. It is commonly reported as fact in newspapers, magazines, and academic journals. An article in the January 1996 Harvard Law Review, for example, invokes the typewriter keyboard as support for a thesis that pure luck is responsible for winners and losers, and that our expectation of survival of the fittest should be replaced by survival of the luckiest.

But this is just the tip of the iceberg. In the Los Angeles Times, Steve Steinburg writes, regarding the adoption of an Internet standard, "[I]t's all too likely to be the wrong standard. From Qwerty vs. Dvorak keyboards, to Beta vs. VHS cassettes, history shows that market share and technical superiority are rarely related." In The Independent, Hamish McRae discusses the likelihood of "lock-in" to inferior standards. He notes the Beta and VHS competition as well as some others, then adds, "Another example is MS-DOS, but perhaps the best of all is the QWERTY keyboard. This was designed to slow down typists...." In Fortune, Tim Smith repeats the claim that QWERTY was intended to slow down typists, and then notes, "Perhaps the stern test of the marketplace produces results more capricious than we like to think."

In a feature series, Steven Pearlstein of The [Washington Post](#) presents at great length the argument that modern markets, particularly those linked to networks, are likely to be dominated by just a few firms. After introducing readers to Brian Arthur, one of the leading academic advocates of the view that lock-in is a problem, he states, "The Arthurian discussion of networks usually begins at the typewriter keyboard." Other prominent appearances of the QWERTY story are found in The [New York Times](#), The Sunday Observer, The Boston Globe, and broadcast on PBS's News Hour with Jim Lehrer. It can even be found in the Encyclopaedia Britannica as evidence of how human inertia can result in the choice of an inferior product. The story can be found in two very successful economics books written for laymen: Robert Frank and Philip Cook's [The Winner-Take-All Society](#) and Paul Krugman's [Peddling Prosperity](#), where an entire chapter is devoted to the "economics of QWERTY."

Why is the keyboard story receiving so much attention from such a variety of sources? The answer is that it is the centerpiece of a theory that argues that market winners will only by the sheerest of coincidences be the best of the available alternatives. By this theory, the first technology that attracts development, the first standard that attracts adopters, or the first product that attracts consumers will tend to have an insurmountable advantage, even over superior rivals that happen to come along later. Because first on the scene is not necessarily the best, a logical conclusion would seem to be that market choices aren't necessarily good ones. So, for example, proponents of this view argue that although the Beta video recording format was better than VHS, Beta lost out because of bad luck and quirks of history that had nothing much to do with the products themselves. (Some readers who recall that Beta was actually first on the scene will immediately recognize a problem with this example.)

These ideas come to us from an academic literature concerned with "path dependence." The doctrine of path dependence starts with the observation that the past influences the future. This conclusion is hard to quibble with, although it also seems to lack much novelty. It simply recognizes that some things are durable. But path dependence is transformed into a far more dramatic theory by the additional claim that the past so strongly influences the future that we become "locked in" to choices that are no longer appropriate. This is the juicy version of the theory, and the version that implies that markets cannot be trusted. Stanford University economic historian Paul David, in the article that introduced the QWERTY story to the economics literature, offers this example of the strong claim: "Competition in the absence of perfect futures markets drove the industry prematurely into

standardization on the wrong system where decentralized decision making subsequently has sufficed to hold it."

According to this body of theory, if, for example, DOS is the first operating system, then improvements such as the Macintosh will fail because consumers are so locked in to DOS that they will not make the switch to the better system (Rush Limbaugh falls for this one). The success of Intel-based computers, in this view, is a tragic piece of bad luck. To accept this view, of course, we need to ignore the fact that DOS was not the first operating system, that consumers did switch away from DOS when they moved to Windows, that the DOS system was an appropriate choice for many users given the hardware of the time, and that the Mac was far more expensive. Also, a switch to Mac required that we throw out a lot of DOS hardware, where the switch to Windows did not, something that is not an irrelevant social concern.

A featured result of these theories is that merely knowing what path would be best would not help you to predict where the market will move. In this view of the world, we will too often get stuck, or locked in, on a wrong path. Luck rules, not efficiency.

Most advocates of this random-selection view do not claim that everything has been pure chance, since that would be so easy to disprove. After all, how likely would it be that consecutive random draws would have increased our standard of living for so long with so few interruptions? Instead, we are told that luck plays a larger role in the success of high-technology products than for older products. A clear example of this argument is a 1990 Brian Arthur article in *Scientific American*. Arthur there distinguishes between a new economics of "knowledge based" technologies, which are supposedly fraught with increasing returns, and the old economics of "resource based" technologies (for example, farming, mining, building), which supposedly were not. "Increasing returns" (or "scale economies") means that conducting an activity on a larger scale may allow lower costs, or better products, or both.

Traditional concepts of scale economies applied to production--the more steel you made, the more cheaply you could make each additional ton, because fixed costs can be spread. Much of the path-dependence literature is concerned with economies of consumption, where a good becomes cheaper or more valuable to the consumer as more other people also have it; if lots of people have DOS computers, then more software will be available for such machines, for instance, which makes DOS computers better for consumers. This sort of "network externality" is even more important when literal networks are involved, as with phones or fax machines, where the value of the good depends in part on how many other people you can connect to.

What Arthur and others assert is that path dependence is an affliction associated with technologies that exhibit increasing returns--that once a product has an established network it is almost impossible for a new product to displace it. Thus, as society gets more advanced technologically, luck will play a larger and larger role. The logical chain is that new technologies exhibit increasing returns, and technologies with increasing returns exhibit path dependence. Of the last link in that chain, Arthur notes: "[O]nce random economic events select a particular path, the choice may become locked-in regardless of the advantages of the alternatives."

This pessimism about the effectiveness of markets suggests a relative optimism about the potential for government action. It would be only reasonable to expect, for example, that panels of experts would do better at choosing products than would random chance. Similarly, to address the kinds of concerns raised in Frank and Cook's *Winner-Take-All Society*, the inequalities in incomes that arise in these new-technology markets could be removed harmlessly, since inequalities arise only as a matter of luck in the first place. It does not seem an unimaginable stretch to the conclusion that if the government specifies, in advance, the race and sex of market winners, no harm would be done since the winners in the market would have been a randomly chosen outcome anyway.

Theories of path dependence and their supporting mythology have begun to exert an influence on policy. Last summer, an amicus brief on the Microsoft consent decree used lock-in arguments, including the QWERTY story, and apparently prompted Judge Stanley Sporkin to refuse to ratify the decree. (He was later overturned.) Arguments against Microsoft's ill-fated attempt to acquire Intuit also relied on allegations of lock-in. Carl Shapiro, one of the leading contributors to this literature, recently took a senior position in the antitrust division of the Justice Department. These arguments have even surfaced in presidential politics, when President Clinton began referring to a "winner-take-all society."

Stanford University economist Paul Krugman offered the central claim of this literature boldly and with admirable simplicity: "In QWERTY worlds, markets can't be trusted." The reason that he uses "QWERTY worlds," and not DOS worlds, or VHS worlds, is that the DOS and VHS examples are not very compelling. Almost no one uses DOS anymore, and many video recorder purchasers thought VHS was better than Beta (as it was, in terms of recording time, as we have discussed at length elsewhere).

The theories of path dependence that percolate through the academic literature show the possibility of this form of market ineptitude within the context of highly stylized theoretical models. But before these theories are translated into public policy, there really had better be some good supporting examples. After all, these theories fly in the face of hundreds of years of rapid technological progress. Recently we have seen PCs replace mainframes, computers replace typewriters, fax machines replace the

mails for many purposes, DOS replace CP/M, Windows replace DOS, and on and on.

The typewriter keyboard is central to this literature because it appears to be the single best example where luck caused an inferior product to defeat a demonstrably superior product. It is an often repeated story that is generally believed to be true. Interestingly, the typewriter story, though charming, is also false.

The Fable

The operative patent for the typewriter was awarded in 1868 to Christopher Latham Sholes. Sholes and his associates experimented with various keyboard designs, in part to solve the problem of the jamming of the keys. The result of these efforts is the common QWERTY keyboard (named for the letters in the upper left hand row). It is frequently claimed that the keyboard was actually configured to reduce typing speed, since that would have been one way to avoid the jamming of the typewriter.

The rights to the Sholes patent were sold to E. Remington & Sons in early 1873. Remington added further mechanical improvements and began commercial production in late 1873. Other companies arose and produced their own keyboard designs to compete with Remington. Overall sales grew, but slowly.

A watershed event in the received version of the QWERTY story is a typing contest held in Cincinnati on July 25, 1888. Frank McGurrian, a court stenographer from Salt Lake City who was purportedly the only person using touch typing at the time, won a decisive victory over Louis Taub. Taub used the hunt-and-peck method on a Caligraph, a machine with an alternative arrangement of keys. McGurrian's machine, as luck would have it, just happened to be a QWERTY machine.

According to popular history, the event established once and for all that the Remington typewriter, with its QWERTY keyboard, was technically superior. Wilfred Beeching's influential history of the keyboard mentions the Cincinnati contest and attaches great importance to it: "Suddenly, to their horror, it dawned upon both the Remington company and the Caligraph company officials, torn between pride and despair, that whoever won was likely to put the other out of business!" Beeching refers to the contest as having established the Remington machine "once and for all." Since no one else at that time had learned touch typing, owners of alternative keyboards found it impossible to counter the claim that Remington's QWERTY keyboard arrangement was the most efficient.

So, according to this popular telling, McGurrian's fluke choice of the Remington keyboard, a keyboard designed to solve a particular mechanical problem, became the very poor standard used daily by millions of typists.

Fast forward now to 1936, when August Dvorak, a professor at the University of Washington, patented the Dvorak Simplified Keyboard. Dvorak claimed to have experimental evidence that his keyboard provided advantages of greater speed, reduced fatigue, and easier learning. These claims were buttressed when, during World War II, the U.S. Navy conducted experiments demonstrating that the cost of converting typists to the Dvorak keyboard would be repaid, through increased typing speed, within 10 days from the end of training. Despite these claims, however, the Dvorak keyboard has never found much acceptance.

In many regards this is an ideal example. The dimensions of performance are few, and in these dimensions the Dvorak keyboard appears to be overwhelmingly superior. The failure to choose the Dvorak keyboard certainly seems to demonstrate that something is amiss. On top of all that, it's a charming tale that is easy to tell, and the moral seems easy to find.

Unfortunately, what is amiss here is not the market choice, but the tale itself. The standard telling of this story turns out to be false in almost every important respect.

Tainted Evidence for Dvorak

The belief that the Dvorak keyboard is superior to QWERTY can be traced to a few key sources. A book published by Dvorak and several co-authors in 1936 presented Dvorak's own investigations, which might charitably be called less than objective. Their book has the feel of a late-night television infomercial rather than scientific work. Consider this from their chapter about relative keyboard performance:

"The bare recital to you of a few simple facts should suffice to indict the available spatial pattern that is so complacently entitled

the universal [QWERTY] keyboard. Since when was the universe lopsided? The facts will not be stressed, since you may finally surmount most of the ensuing handicaps of this [QWERTY] keyboard. Just enough facts will be paraded to lend you double assurance that for many of the errors that you will inevitably make and for much of the discouraging delay you will experience in longed-for speed gains, you are not to blame. If you grow indignant over the beginner's role of innocent victim, remember that a little emotion heightens determination. Analysis of the present keyboard is so destructive that an improved arrangement is a modern imperative. Isn't it obvious that faster, more accurate, less fatiguing typing can be attained in much less learning time provided a simplified keyboard is taught?" Unfortunately, their statement that they will not stress the facts appears truthful.

Dvorak and his co-authors claimed that their studies established that students learn Dvorak faster than they learn QWERTY. But they compared students of different ages and abilities (for example, students learning Dvorak in grades 7 and 8 at the University of Chicago Lab School were compared with students learning QWERTY in conventional high schools), in different school systems, taking different tests in classes that met for different lengths of time. One doesn't need to be a scientist to realize that such comparisons are not the stuff of controlled experiments. Even in their studies, however, the evidence is mixed as to whether students learning Dvorak retain an advantage, since the differences seemed to diminish as training progressed.

But it is the Navy study that is the basis for the more extravagant claims of Dvorak's advocates. That is the study that supposedly established that the entire retraining cost is recaptured 10 days after the start of retraining.

Since several academic authors, including Paul David, have made reference to this Navy study, we assumed it would not be too difficult to find. But when we started to look for it, it seemed to have disappeared from the face of the earth. After trying our own libraries, we tried the Navy Library, the Martin Luther King Library, the Library of Congress, the National Archives, the National Technical Communication Service, and so forth. The librarians were more helpful than we had any right to expect, but the results of their efforts seemed to indicate that we would not find the Navy study.

Had any of the modern authors who referred to the Navy study as supporting Dvorak's keyboard ever actually read it? This appears to be one of those cases in which one author relies on another's account, who in turn is relying on another's, and so on, without any of them reading the original. Yet the Navy study is a primary source of many of the claims for the Dvorak keyboard. This is certainly not a high watermark in scholarship.

We had about given up hope when we located a copy of the study held by an organization called Dvorak International, headquartered in the attic of a farmhouse in Vermont. The report does not list the authors. The report's foreword states that two prior experiments had been conducted but that "the first two groups were not truly fair tests." This certainly raised our suspicions. Might those earlier tests have been ignored because the results were inconsistent with the results the authors desired? This suspicion was later reinforced when we read about a 1953 study for the Australian Post Office. In the early phases of the Australian study, the experiments showed no advantages for Dvorak. But then adjustments were made in the test procedure to "remove psychological impediments to superior performance." We can only guess how the proponents of the Dvorak keyboard, who conducted the experiments, might have removed those nasty impediments.

As to the experimental design of the Navy study, we can only state that if the experimental controls seemed bad in the early studies authored by Dvorak and his associates, the Navy study seems even worse.

First, 14 Navy typists were retrained on newly overhauled Dvorak typewriters for two hours a day. We are not told how the typists were chosen, although we are told that they had initial typing speeds of 32 words per minute, well below the Navy's standard of competence. Yet in spite of their poor typing skills, the typists had IQs only two points below average and dexterity skills 15 points above average. Based on these abilities, this group of typists should have been expected to type at far above minimal competency. After completing 83 hours on the new keyboard, we are told that the typing speed for this group had increased to an average of 56 net words per minute, a 75 percent increase.

A second part of the experiment consisted of the retraining of 18 typists on the QWERTY keyboard. These typists reported a 28 percent increase in typing speed from their initial speed of 29 words a minute.

Although this evidence looks like a slam-dunk for Dvorak, it is not.

First, it is not clear how the QWERTY typists were picked, or even if members of this group were aware that they were part of an experiment. The participants' IQs and dexterity skills are not reported for the QWERTY retraining group. Were their abysmal typing scores surprising, given their inherent abilities? It is difficult to have any sense whether this group is a reasonable control for the first group. Nor do we know if the QWERTY typewriters were newly overhauled. Nor do we know who retrained these typists.

Even worse, there is clear evidence that the results were altered through a series of inappropriate data manipulations. For example, the initial typing scores for the QWERTY typists were measured differently from the initial scores of the Dvorak typists so as to greatly disadvantage the QWERTY results. The report states that, because three typists in the QWERTY group had initial net scores of zero words per minute (!), the beginning and ending speeds were calculated as the average of the first four typing tests and the average of the last four typing tests. This has the effect of raising the measured initial typing speed, and lowering the measured ending speed. In contrast, the initial experiment using Dvorak simply used the first and last test scores. Using numbers reported in the footnotes of the report, we were able to calculate that this truncation of the reported values at the beginning of the test reduced the measured increase in typing speed on the QWERTY keyboard by almost half. The effect of the truncation at the end of the measuring period also decreases the reported gains for the QWERTY typists, though the size of this distortion cannot be determined from the report. The important thing, however, is that the numbers appear to be cooked in favor of Dvorak.

How can we take seriously a study which so blatantly seems to be stacking the deck in favor of Dvorak? And, indeed, there appears to have been good reason for that deck stacking.

We discovered that the Navy's top expert in the analysis of time and motion studies during World War II was none other than...drum roll please...Lieut. Com. August Dvorak. Earle Strong, a professor at Pennsylvania State University and a one-time chairman of the Office Machine Section of the American Standards Association, reports that the 1944 Navy experiment was conducted by Dvorak himself. Strong was heavily involved with these issues. He was the author of a key test of the typewriter keyboard commissioned by the General Services Administration.

As if the potential for bias were not great enough, we also discovered that Dvorak had a financial stake in this keyboard. He not only owned the patent on the keyboard but had received at least \$130,000 from the Carnegie Commission for Education for the studies performed while he was at the University of Washington, a rather stupendous sum for the time.

Of course, the purported Navy results, if true, would be quite remarkable. After those first 10 days in which the investment is made and recovered, the faster typing continues every working day in the life of the typist. This would imply that the investment in retraining repays itself at least 23 times in one year. Does it seem even remotely possible that employers with large typing pools would turn down investments with returns of 2,200 percent a year?

Evidence Against Dvorak

Naturally, these false results were going to get found out. As many businesses and government agencies contemplated changing keyboards in the mid 1950s, the General Services Administration commissioned Strong's study to confirm the earlier results. This study provides the most compelling evidence against the Dvorak keyboard. It was a carefully controlled experiment designed to examine the costs and benefits of switching to Dvorak. It unreservedly concluded that retraining typists on Dvorak was inferior to retraining on QWERTY.

In the first phase of the experiment, 10 government typists were retrained on the Dvorak keyboard. It took well over 25 days of four-hour-a-day training for these typists to catch up to their old QWERTY speeds. (Compare this to the Navy study's results.) When the typists had finally caught up to their old speeds, the second phase of the experiment began. The newly trained Dvorak typists continued training and a group of 10 QWERTY typists (matched in skill to the Dvorak typists) began a parallel program to improve their skills. In this second phase the Dvorak typists progressed less quickly with further Dvorak training than did QWERTY typists training on QWERTY keyboards. Thus Strong concluded that Dvorak training would never be able to amortize its costs. He recommended instead that the government provide further training in the QWERTY keyboard for QWERTY typists.

The GSA study attempted to control carefully for the abilities and treatments of the two groups. The study design directly paralleled the decision that a real firm or a real government agency might face: Is it worthwhile to retrain its present typists? If Strong's study is correct, it is not efficient for current typists to switch to Dvorak. The study also implied that the eventual typing speed would be greater with QWERTY than with Dvorak, although this conclusion was not emphasized.

Much of the other evidence that has been used to support Dvorak's superiority actually can be used to make a case against Dvorak. We have the 1953 Australian Post Office study already mentioned, which needed to remove psychological impediments to superior performance. A 1973 study based on six typists at Western Electric found that after 104 hours of training on Dvorak, typists were 2.6 percent faster than they had been on QWERTY. Similarly, a 1978 study at Oregon State University indicated that after 100 hours of training, typists were up to 97.6 percent of their old QWERTY speed. Both of these retraining times are similar to those reported by Strong but not to those in the Navy study. But unlike Strong's study neither of these studies included parallel retraining on QWERTY keyboards. As Strong points out, even experienced QWERTY typists increase their speed on QWERTY if they are given additional training.

Ergonomic studies also confirm that the advantages of Dvorak are either small or nonexistent. For example, A. Miller and J. Thomas, two researchers at the IBM Research Laboratory, writing in the *International Journal of Man-Machine Studies*, conclude that "no alternative has shown a realistically significant advantage over the QWERTY for general purpose typing." Other studies based on analysis of hand-and-finger motions find differences of only a few percentage points between Dvorak and QWERTY. The consistent finding in ergonomic studies is that the results imply no clear advantage for Dvorak, and certainly no advantage of the magnitude that is so often claimed.

QWERTY's Competition

Remington's early commercial rivals were numerous, offered substantial variations on the typewriter, and in some cases enjoyed moderate success. This should come as no surprise. Entrepreneurs in the late 19th century would have realized that the typewriter market was potentially vast, in the same way that Netscape, AT&T, and Microsoft are drooling over the potential of the Internet at the end of the 20th century.

The largest and most important QWERTY rivals were the Hall, Caligraph, and Crandall machines, which sold in relatively large numbers. Two other manufacturers offered their own versions of an ideal keyboard: Hammond in 1893 and Blickensderfer in 1889. Many of these companies went on to success in the typewriter market, although, in the end, they all produced QWERTY keyboards. So manufacturing prowess was not a problem for QWERTY's rivals.

In the 1880s and 1890s typewriters were generally sold to offices not already staffed with typists. Potential typists were learning to type from scratch. A manufacturer that chose to compete using an alternative keyboard had a window of opportunity, since standards were not yet established. As late as 1923, typewriter manufacturers operated placement services for typists and were an important source of typists to businesses. A keyboard that allowed more rapid training and faster typing should have done well. And switching old typewriters to a new keyboard was not particularly expensive--only \$5.00 for resoldering in the 1930s.

There were also direct tests of these competing keyboards. Typing competitions, it turns out, were quite common in the late 1800s. The Cincinnati contest was not the rare event claimed by Beeching, and McGurrin was not the world's only touch typist. Once again, the facts have been twisted to make a better tale. We did a search in [The New York Times](#) in 1888 and 1889. We found numerous typing contests and demonstrations of speed involving many different machines, with various manufacturers claiming to hold the speed record.

In February 1889, under the headline "Wonderful Typing," *The New York Times* reported on a typing demonstration given the previous day in Brooklyn by Thomas Osborne of Rochester, New York. The Times reported that Osborne "holds the championship for fast typing, having accomplished 126 words a minute at Toronto August 13 last." In the Brooklyn demonstration he typed 142 words per minute in a five-minute test, 179 words per minute in a single minute, and 198 words per minute for 30 seconds. He was accompanied by George McBride, who typed 129 words per minute blindfolded. Both men used the non-QWERTY Caligraph machine.

The Times offered that "the Caligraph people have chosen a very pleasant and effective way of proving not only the superior speed of their machine, but the falsity of reports widely published that writing blindfolded was not feasible on that instrument." Note that this was just months after McGurrin's Cincinnati victory.

There were other contests and a good number of victories for McGurrin and Remington. On August 2, 1888, just weeks after the Cincinnati contest, the Times reported a New York contest won by McGurrin with a speed of 95.8 words per minute in a five-minute dictation. In light of the received history, according to which McGurrin is the only person to have memorized the keyboard, it is interesting to note the strong performance of his rivals. May Orr typed 95.2 words per minute, and M Grant typed 93.8 words per minute. Again, on January 9, 1889, the Times reported a McGurrin victory under the headline "Remington Still Leads the List."

Clearly, typists other than McGurrin could touch type, and machines other than Remington were competitive. These events have largely been ignored. But if we are interested in whether the QWERTY keyboard's existence can be attributed to more than happenstance or an inventor's whim, these events are crucial. The other keyboards did compete. They just couldn't surpass QWERTY. So we cannot attribute the success of the QWERTY keyboard either to a lack of alternatives or to the chance association of this keyboard arrangement with the only touch typist or the only mechanically adequate typewriter.

There is further evidence of QWERTY's viability in its survival throughout the world. As typing moved to countries outside the United States, any QWERTY momentum could have been only a minor influence, yet the basic configuration has been adopted

with only minor variations in virtually all countries with similar alphabets. What's more, the advent of computer keyboards, which can easily be reprogrammed to any configuration, lowers the cost of converting to Dvorak to essentially zero (not counting retraining). Yet few computer users have adopted the Dvorak keyboard.

Epilogue

The vitality of markets is that they allow competing alternatives to demonstrate their capabilities. The primary players in this drama are entrepreneurs, a group largely missing from the economic theories that claim to establish the potential for this new kind of market failure. These game-theory models limit firms to an artificially narrow choice of actions, while actual entrepreneurs look for ways to overcome supposed "lock-in." In theory, for instance, there's no such thing as a training course. Entrepreneurs, as we have argued in other writings, are the ones who will bring about the demise of an inefficient standard. Producers of alternative keyboards were motivated to cash in on the success allowed in a market-based economy. That they failed suggests that the non-QWERTY arrangements held no real advantage.

The QWERTY keyboard cannot be said to constitute evidence of any systematic tendency for markets to err. Very simply, no competing keyboard has offered enough advantage to warrant a change. The story of Dvorak's superiority is a myth or, perhaps more properly, a hoax.

In April 1990, we published a more detailed version of this material in a Journal of Law and Economics article titled "The Fable of the Keys." This journal is well known and has published some of the most influential articles in economics. In the six years since we published that article there has been no attempt to refute any of our factual claims, to discredit the GSA study, or to resurrect the Navy study. Unless some new evidence is produced to support a claim of QWERTY's inferiority to Dvorak, how can it even be said that there are two sides to a legitimate scientific disagreement over the keyboard?

Yet the QWERTY myth continues to be cited as if it were the truth. Krugman's book has a 1994 copyright. Frank and Cook's copyright is 1995. In a 1992 article in *Industrial and Corporate Change*, Paul David cites the QWERTY example, as do Michael Katz and Carl Shapiro in their Spring 1994 article in the *Journal of Economic Perspectives*.

In a 1995 article on chaos theory, Michael Schermer goes on at length about the need for examples of path dependence. With that, he devotes an entire section, titled "The QWERTY Principle of History," to repeating the myth of Dvorak superiority. The Social Science Citation Index for 1994 shows a total of 28 citations to Paul David's 1985 *American Economic Review* article presenting the QWERTY myth (the very large majority of these are uncritical uses of the QWERTY story). And there is no sign of abatement. The Citation Index for the first two-thirds of 1995, which is all that is available as of this writing, shows 25 citations. If academics keep using a false example, authors of popular articles can hardly be held to higher standards of scholarship.

Apparently the theory of path dependence and lock-in to inferior technologies is in trouble without the QWERTY example. Apparently the cost of giving up this example is greater than the discomfort associated with its illegitimate use. Apparently the typewriter example is of such importance to many writers because it can so easily persuade people that an interventionist technology policy is necessary. How else to explain its continued use in this literature? Since an interventionist technology policy is no more likely to benefit consumers than are the myriad other government interventions in the market, we should not be surprised that good examples are largely fictional.

Try Reason's award-winning print edition [today!](#) Your first issue is FREE if you are not completely satisfied.