THE TEN BEST WAYS TO EMBARRASS A HUMAN FACTORS SPECIALIST

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For the past several years, I have been collecting a list. The list represents all the frequently well-intentioned, but usually critical, comments that we encounter when we try to introduce human factors work into new design environments. So far, I've gotten up to ten, but when the reader sees how it goes, I am sure he will want to add to my list.

While I hope the reader finds this set of comments entertaining and that many of his own sensitivities are reflected in it, my main purpose is to try to communicate why I believe we have matured as a discipline to the point where we don't need to be embarrassed by them anymore or take a defensive posture.

Human factors is nothing more than the application of common sense.

There are basically three different ways to deal with this comment. First, it can be argued that it is true – a certain amount of the work in human factors reflects the application of common sense. Nevertheless, somehow without the input of human factors specialists, this kind of common sense seems too often to be overlooked. Everyone has his own favorite examples of this phenomenon. Over the street intersections in many parts of Canada, you will see a sign next to the stoplight, which says "Advanced Green When Flashing." I puzzled for several stoplights and had to observe the behavior of the vehicles at such intersections carefully before I understood the meaning of this sign. It could be better expressed as "Left Turn on Flashing Green".

A second and perhaps more critical example concerned the design of a snowblower which was the subject matter of a personal liability lawsuit. One issue in the case concerned the hazards of getting a hand caught in the impeller blades. A warning label was placed on the handlebars where it could be seen by anyone operating the machine, which said something like, "Do Not Leave the Operating Position without Disengaging the Impeller Clutch." As the reader is probably aware, the principle of operation of a snowblower depends on the high-speed revolution of an impeller, which throws the snow out the chute. On this particular machine, the clutch engagement lever controlling the impeller was mounted at the side of the machine right next to the chute. It required the user to leave the back of the machine (a violation of the warning label), walk around to the side, and place his hand in a position right next to the chute in order to disengage the very clutch referred to in the label. The potential hazard is obvious.

The second perspective for dealing with this issue argues that almost everything is common sense when you view it with hindsight. I am reminded of the quote offered by Chapanis (1966):

> *Outside of the proven impossible, there probably can be found . . . no field where so much inventive seed has been sown with so little return as in the attempts of man to fly successfully through the air. It may be truly said that, so far as the hope of a commercial solution of the problem is concerned, man is today no nearer fulfillment than he was ages ago when he first dreamed of flying through the air. . . . A calm survey of certain natural phenomena leads the engineer to pronounce all confident prophecies at this time for future success as wholly unwarranted, if not absurd.*

This quotation was authored by Rear Admiral Melville, then engineer-in-chief of the United States Navy in 1901, 2 years before the first successful flight at Kitty Hawk.

It is certainly true that, after the fact, it is easy to make almost any result appear to be common sense. It takes study and sometimes experimentation to predict what will be common sense and to put those predictions on a quantitative basis. The goal of much human factors work is to predict what will become common sense after the fact.

Finally, it is not all that difficult to find examples in which the human factors principle to be applied is not common sense at all. One example that always surprised me was the effect of requiring simultaneous performance of tasks having different initial levels of difficulty. I would expect that the more difficult of the two tasks would suffer more on the introduction of a second task, but in fact, it is the easy task whose performance degrades in comparison with the single task control performance.

A second example, first reported to me by Dr. Irwin Pollack, is the idea that, in a noisy environment, you can hear speech better if you put your fingers in your ears. The technical reason for this result is that the fingers in the ears provide selective filtering of the signals from the outside; admitting frequencies in the speech range better than frequencies outside that range. I doubt that anyone would argue that this is simply an application of common sense.

Yes, some human factors principles are common sense, and others become common sense with hindsight, but in all of these cases, it takes a professional to understand how and when such commonsense knowledge applies.

The human factors consultant I hired didn't tell me anything I could not have thought of myself.

This assertion could be regarded as a corollary of the commonsense issue. The individual who made it is very good at understanding a good idea after it is presented to him. For purposes of this discussion, I would like to take it as a comment on the level of quality control within our discipline. There are good and bad consultants in every field. We must continue to be concerned about the issue of quality control. At its October 1978 council meeting, the Executive Council of the Human Factors Society spent more than an hour discussing how to come to grips with the evaluation of the quality of our specialists.

There is currently much discussion nationwide about licensing professionals, and such licensing requirements are being imposed by state legislatures today in many disciplines. We need to take the initiative to do it ourselves, to meet our own needs before licensing standards unacceptable to us are imposed by the legislative powers. I think you will begin to see proposals of this kind from the 1979 Executive Council.

The research you people do is too abstract to be useful to me.

I have frequently heard the criticism that the journal *Human Factors* is too researchy. I don't think you should expect everything you read in the journal to be useful to you immediately. One purpose of a journal is to advance the state of knowledge in the field. This is a gradual process.

The individual who makes this comment needs to understand that it takes time to see researchpay off. Let me take two examples of some of the more abstract work that has been developed in our field.

Work began 20 years ago on engineering models for manual control of vehicles. These models are being used actively today for pre-simulation analysis of vehicle handling qualities, both in aircraft and automotive applications.

Signal detection theory has not only changed considerably our view of sensory measurement, but has recently become the basis for a very practical standard evaluation protocol for examining the usefulness of radiographic imagery by the National Cancer Institute.

I actually believe human factors specialists are in a better position to produce *useful* research than your average university academic. There is no better research than that which grows out of

practical needs. The problem now is the opposite. Usual sources of support, particularly the Department of Defense, are directing their resources to short-sighted applied development projects rather than longer term research activity.

Of course, as a matter of fact, we need *both* competent research motivated by practical questions and careful case studies which systematically explore the range of parameters that would support improved design directly.

That's a great concept for improving performance, but you just can't build it that way.

This is, indeed, a frequent criticism of the psychologist or physiologist working in an engineering environment. But let the engineer be patient with us. A human factors specialist worth his salt will learn rapidly what the engineering design and cost constraints are. Our field depends on the ability to make trade-offs between human factors issues on the one hand and design and cost constraints on the other.

The engineer will also want to be careful when he uses this gambit that he is not exposing his own flank. Human factors specialists can often say, "That's a fine design, but an operator just won't use it that way." Too often this expression is used as a stock phrase to close off discussion. Don't let the designer close off his options too soon.

Human factors input is not important. People are so adaptive they learn to overlook the deficiencies of a system that is hard to use.

While I have heard this point argued many times, I should not have to belabor it with this audience. It is well known that compatible designs are more resistant to the errors induced by time stress or workload stress. It is well known that the most important contributor to safety is design that meets good human factors principles in the first place. It is true that people are adaptable and that, after experience with a system, they have great difficulty reporting on its shortcomings, but that does not mean that their efficiency and effectiveness are not reduced.

The education of a human factors specialist is not complete if he or she has not been exposed to the classic story of an ingenious experiment reportedly conducted at the Bell Telephone Laboratories during World War II.

The telephone company was concerned about ways to save copper, and one use of copper was in the cable connecting the telephone handset to the tabletop set. The experimental question was, "How long does a telephone cord need to be?" The investigators identified a series of test telephones around the laboratory. Each night, they went to those telephones and reduced the length of the line cord by one inch and replaced the telephone in its normal position on the desk. They then designated a special telephone operator to receive complaints about the telephones. Day by day, the line cords got shorter, and one by one, their users began to complain to the special operator. When the line cord had reached a given length, about half of the participants had complained, and this process continued until the line cord was only a few inches long. There remained one person who still had not complained. The investigators decided to check up on him. One of them visited his office while the second called him on the telephone. Sure enough, when the telephone rang, he leaned over his desk so that his ear could reach the handset, and he answered the phone in a very awkward manner indeed. When asked later if there was anything funny about his telephone, he said, "Oh, the line cord is a little short, but that doesn't concern me."

As I said, people are very adaptable, but that doesn't justify a poor design.

The handbooks never have recommendations for the conditions I need.

I think this statement is frequently true and can be very discouraging to the practicing designer. In other fields, this problem is solved by teaching theory and models that will predict the specific case of interest. In a few areas, we can do that too, but in many areas, we must be satisfied with concepts and principles and call on our experience and knowledge to understand how and when they apply. This criticism carries with it the implication that we must do more laboratory and field testing than is required in some other disciplines, and this brings us to the next two issues.

The study you propose will take six months – I need an answer tomorrow.

(Or Its Corollary)

The study you propose will cost $100,000 – the budget for my whole project is only $50,000.

There is never enough time or resources to solve a practical problem the way you think you ought to solve it. The best answer to this issue is to anticipate the problem and develop in-house expertise ahead of time. Particularly in the consumer product industry, the characteristics of the issues to be addressed do not change drastically from one model to another. It is practical to use the resources required to undertake a series of generic studies to address issues that it is clear will be continuing issues for a particular kind of product. Begin the work early that will have a payoff for the next design effort in that particular product line.

There is one other message here. There is a strong drive among human factors specialists, especially those who obtained their experimental design training in psychology, to insist on complete symmetric factorial designs. These are costly, time consuming, and grow to unmanageable size as the designer tries to add that one last interesting variable. Many times factorial designs are used as a substitute for careful thought and analysis of exactly what data are needed to solve the problem. It is the analysis that calls on all the specialist's knowledge and experience. The goal should be to obtain results of *practical* importance to design. In such cases, statistical significance, while important, will be a natural fallout. Sometimes you will only have the time and resources to do a crude experiment that aids your intuition and supports your background and experience. Sometimes you will have no opportunity to experiment at all. After you have screamed at management for giving you inadequate resources, and management continues to demand an answer, pause for a moment and ask yourself, "Would I rather have someone else making this decision?"

After I get this system working, then I'll look into human factors questions, if I have any time left.

This assertion is all too often offered. We are plagued with being left out, with getting in after the major decisions have been made, or being offered the role of pervade[?] of checklists and performancesign-offs. My own belief is that getting in early, we can have orders of magnitude influence on system performance. But when getting in late, our influence is reduced to percentage points. Getting in early depends on management, and that leads me to the next issue.

You have converted me, now can I convince my boss that human factors work is important?

In seeking an answer to this issue, think about the goals of human factors work.

1. *Improving the productivity and efficiency of performance*; any time you can reduce the time or increase the accuracy of performance, you have reduced manpower requirements and thereby costs.

2. *Reducing personnel selection and training requirements*; minimizing the selection criteria you must impose, and the training effort required for development of adequate personnel can be directly translated into dollar savings.

3. *Improving the safety of a product*; safety has large indirect payoffs in terms of reduced legal liability. The costs of exposure to personal liability cases involving negligence in design have become a real dollar cost to most major industrial organizations.

4. *Promoting consumer acceptance*; acceptance has become a major source of motivation for improved human factors in design.

More and more systems are being sold as complete packages, with application design as an integral part of the system itself. Under these conditions, the human factors aspects of the design become an integral part of its competitive advantages.

The toughest part of convincing management is to create a reputation when you are just beginning. If your group is relatively new and inexperienced, chances are you have been confronted with a number of possible problems on which to work. For your first efforts, my advice is to select among all the problems you are offered, not the most challenging or most interesting, but the one on which you think you can have the most impact with the smallest risk. Solve it, and then sit back and accumulate the credit. It doesn't take very long before potential customers are beating down your door with their problems.

So much for the ten potential embarrassments. I hope I have convinced you that you need not be defensive about them. In my view, we are currently in a phase where human factors work is receiving unprecedented acceptance. Military budgets for human resources research and development continue to rise. More organizations are initiating human factors programs. Professor Chapanis, at our annual council meeting, reported his first inquiry from a labor union in this country. Several Western European countries have introduced legislation mandating the use of ergonomic principles in the design of the workplace. One large industrial organization has reported to me that they believe their future lies in a corporate commitment to improved human factors design of their products. In the group with whom I am affiliated at the Social Security Administration, there has been a turnaround in the last 2 years from disinterested skepticism to an insistent demand for human factors results they can use.

In short, I have never been more enthusiastic about my profession and its potential for serving as one interface between technology and society. I hope you share my enthusiasm!