EVERYBODY KNOWS – OR DO THEY?

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Presidential addresses, like presidents, seem to come in a variety of sizes and shapes. As I reviewed the addresses of some of my distinguished predecessors, I noted they included presentations of research, analyses of the current state of some substantive area of work, analyses of the discipline, including our own society, and sprinklings of predictions and exhortations about the future.

As I thought about an appropriate topic or subject matter for my address, two general self-observations emerged immediately. First, I decided, or realized, that I am not good at predicting the future. My crystal ball has always been hazy, the lines in my palms seem silent, and I make my tea with tea bags not tea leaves. So, except for a few comments about opportunities for human factors specialists and ergonomists near the end of my talk, I will leave futuristic prognostications to others more talented than I. The second self-observation in considering an appropriate topic was, of course, the kinds of subjects about which I knew enough about to put together an address. This consideration immediately led to a substantial reduction in the alternatives.

So, today I am going to talk about a problem that I believe exists in our American society. It is a safety problem; that is, it concerns reasons, or causes, as to why accidents occur, property gets damaged, and people get hurt. It might be labeled the "Everybody Knows Problem." My plan is to define or describe the problem, to give you some examples of circumstances or situations in which it exists, to share some thoughts about why it exists, and then to talk about where human factors/ergonomics specialists fit with regard to addressing it, or putting it another way, what are some opportunities and/or responsibilities that it creates for people like us.

The "everybody knows" problem is essentially this: Engineers, architects, and designers of other stripes often design products and environments that have associated safety problems – hazards. The safe use of these products requires some knowledge or information on the part of users, which the users – at least some of them – may not or do not have. The design process frequently includes little or no attention to the knowledge requirements of users and/or the knowledge states of users. Worse still, where knowledge requirements are addressed, inappropriate assumptions are often made as to what people know or what they will do, and seldom is any effort made to assess whether or not such assumptions are valid.

The "everybody knows" problem is part of a general class of safety problem that has been around for a long time. Susan Hadden, in her book *Read the Label* (1986), noted that for centuries the implicit doctrine governing consumer products was caveat emptor, or "let the buyer beware."

This doctrine assumed that consumers would use their intelligence and experience to protect themselves. Certainly we have witnessed some changes in such attitudes in recent decades, and we have seen an increase in concern for consumer safety here in the United States. But the problem has not gone away; indeed, it is very much with us.

The "everybody knows" problem also has a sister (or brother) problem with which human factors and ergonomics specialists are familiar. It goes under the rubric "common sense." Most of us have probably had the experience of listening to a physical scientist, an engineer, a wife, a husband, or a friend say: "Isn't human factors just common sense?" There is an excellent treatment of this issue in Chapanis's classic book *Research Techniques in Human Engineering* (1959), where he says: "Common sense is too shifty a standard upon which to base design decisions. A science of human engineering built on common sense is like a house built on quicksand." The point is that commonsense ideas not only change, they are often wrong.

There is a parallel between the "everybody knows" problem as it relates to safety and the kinds of problems Donald Norman addressed in his excellent book, *The Psychology of Everyday*

Things (1988). Norman drew on numerous examples of common things in our everyday lives that were designed in ways that did not adequately consider characteristics, limitations, and knowledge of users. A major focus of his analyses was the way in which performance and utility are affected by the mismatches between things and the people who use them.

Another related issue is that we seem to have a predisposition in our culture to believe that when an accident occurs, it is because someone screwed up, usually the person who was injured. Those who have worked in industrial safety are familiar with Heinrich's (1941) work in the 1930s proclaiming that 85% of industrial accidents are caused by human error. That work had enormous effects on thinking about industrial safety. What has struck me is how pervasive this way of thinking about accidents and injuries is. It extends to almost every kind of product or situation in our everyday lives.

I've come to the conclusion that the "everybody knows" problem represents one of the most important safety issues we face. This conclusion is based partly on the statistics: Currently about 21,600 product-related deaths and 28.5 million product-related injuries occur each year. But it is also based on discovering that the problem seems to show up in a wide variety of products.

EXAMPLES

My examples of the "everybody knows" problem represent an attempt to show some variety in the nature and extent of the problem.

BabyCushion

A product first appeared in the marketplace in the early or mid-1980s which I will refer to as a baby cushion, though different manufacturers (about 10 in all) had different names for it. These cushions tended to be soft, fluffy, about 2 feet long, 1 foot wide, and 4 or 5 inches thick. The baby was placed on the cushion on its stomach with its head to the side to sleep. The hazard here is that the baby would get its face down in the pillow and suffocate. Dozens of infant deaths over a couple of years ultimately led the Consumer Product Safety Commission to ban such products, based in part on a thorough human factors analysis by Shelly Deppa (CPSC internal memorandum, 1990).

What did users of this type of product – usually parents of infants – know and not know about this hazard? Some data collected on this issue indicated that perhaps more than half of them did not perceive suffocation to be a hazard associated with placing the baby on its stomach on the cushion. Why don't people perceive this hazard? There are some interesting dimensions to the perception and knowledge problem. Here are a few relevant observations:

- In the United States it is common practice to place a baby on its stomach to sleep.
- Crib mattresses are more solid than the cushions and do not present a suffocation hazard.
- Babies tend to cause an indentation in their pillow when they turn and wiggle their heads. Concentrations of carbon dioxide tend to build up in the indentation, causing the baby to breathe faster and harder, exacerbating the problem.
- When the infant's face presses on the pillow, soft cartilage in its nose limits airflow.
- More than a third of infants up to three months old are not mouth breathers. That is, if the nasal passage becomes blocked, they do not begin breathing through the mouth.

How many young parents in their 20s would you guess have the knowledge to understand the suffocation hazard associated with the cushion? Some data collected in the Rice University Human Factors Laboratory on this matter indicate that many do not.

Tire-Rim Size Mismatches and Explosions

In the mid-1960s manufacturers introduced a 16.5-inch tire and rim combination for light trucks. Prior to that time the common size was 16 inches, and the 16-inch size has continued to be marketed. Since the 1960s, there has been a history of accidents, often including injury or death, in which a 16-inch tire was inadvertently mounted on a 16.5-inch tire rim.

During efforts to inflate the tire after it has been placed on the wrong-sized rim, the tire will not properly seat on the rim, the beads in the tire fail, and the tire ruptures with explosive force. Perhaps a few thousand such accidents have occurred, and there is no evidence that on even one occasion the person knew he or she was dealing with a size mismatch.

An analysis of the products and some survey research on what vehicle owner and tire changer know about the problem revealed the following:

- The outer flange diameter of the 16- and 16.5-inch rims are the same. If examined from the side, the two rims look, and are, alike.

- Size markings and codes on the rims are frequently difficult to determine.

- Because of the like flange diameters, the 16-inch tire will go onto the 16.5-inch rim with the same level of ease or difficulty that it goes onto a 16-inch rim. Thus, when that part of the task is being carried out, the tire changer is receiving information that the mounting task is proceeding correctly.

- Most people who work as tire changers – and certainly most of those who may be changing their own tire – do not know about the mismatch problem and hazard.

Hair Dryers and Bathtub Electrocutions

Many people are aware that operating an electrical appliance, such as a hair dryer, around water is dangerous. But these same people may not understand that the hair dryer, when turned off but still plugged in, poses a life-threatening hazard.

Automatic Shoulder Belts in Automobiles, Lap Belt not Fastened

Research at the Highway Safety Research Center of the University of North Carolina (Reinfurt, St. Cyr, and Hunter, 1990) indicates that lap belts are fastened only 29% of the time when there are motorized, automatic shoulder belts. One finding of the study was that many drivers incorrectly perceive that they are fully protected because the shoulder portion of the restraint automatically moves into place. Like the 16-inch tire going on the 16.5-inch rime, here is an example of a characteristic or property of the product leading to a *false perception of safety*.

Over-the-Counter Medications: Side Effects and Contraindications

Some medications have side effects, such as drowsiness, that can be hazardous when performing tasks such as driving. Others may have important contraindications – that is, they

should not be taken if some other condition exists. People tend to underestimate such hazards because the medications are not prescriptive.

REASONS PEOPLE DO NOT KNOW

Why don't people know about the hazards associated with common products such as those just described? Below are some possible explanations for why people do not perceive a product as hazardous and why they often do not think about hazards at the proper times.

The Hazard Is Hidden

In the law there is a concept of an open and obvious hazard. In essence, this concept refers to the notion that the design or function of a product itself communicates the hazard. A sharp knife blade that can cut, or function of a product itself, communicates the hazard. A sharp knife blade that can cut or the possibility of a fall from a high place are examples of open and obvious hazards. But a great many hazards do not fall into this category, and they can be characterized as hidden. Several of the product hazards cited earlier fit this category.

New Technology

Recent decades have witnessed the development of new technology at an ever-increasing pace. These developments show up not only in electronic products but in products influenced by advances in chemistry and biology. Pesticides, herbicides, insecticides, cleaning agents, and solvents are some examples. Many such products have ingestion, inhalation, and skin contact hazards that are not generally known or appreciated by many people.

Misleading Information

In using the term *misleading,* I am not referring to the notion that people are intentionally misled, for example, by false information on a label. Such circumstances may occur, but I have in mind a somewhat different kind of situation: something about a product that indicates it is safe when in fact it is not. Putting a 16-inch tire on a 16.5-inch rim fits in the category of misleading information for two reasons: the 16- and 16.5-inch rims look almost exactly alike, and the fact that the tire goes on the 16.5-inch rim as if it belonged there is telling the person changing the tire that everything is OK. The perception that the automatic shoulder belt in our cars means we are safe is another example.

Accidents Are Rare Events

We are frequently exposed to accident statistics, but the fact is that for most individuals, an accident accompanied buy an injury is a rare event. This point has at least two implications. First, the fact that accidents are rare provides little opportunity to learn more about their causes. Second, people are less likely to attend to or ask questions about safety issues.

Bad Mental Models

Norman (1988) addressed the problems of inappropriate mental models. If the user's model of the product of environment – what it is and how it functions – is inappropriate or wrong, hazards and risks may fail to be perceived or understood.

THE DESIGNER'S PERSPECTIVE

What about the people who design and market consumer products? Why do they not adequately address these issues of consumer hazard perception and knowledge?

The concern is certainly not new. For nearly half a century, members of the human factors discipline have been advocating, pushing, hustling, and preaching that the person component must be addressed more seriously in the design of systems involving people. We have made some significant progress along these lines, but we still have a long way to go.

History

Because people are so adaptive and because, until the past several decades, systems have been relatively simple, we got by without giving the people component the attention it deserved. So, from a historical perspective, designers have had to learn – and many still have to learn – to think this way.

Cognitive Characteristics and Limitations

I recently examined a book by Gloss and Wardle titled *Introduction to Safety Engineering* (1984). The book devoted approximately 11 pages to the topic of ergonomics; actually, these pages consisted of four brief sections on the topic scattered across chapters. Nowhere was there any mention of hazard or risk perception or knowledge – or, for that matter, anything that resembled them. This is symptomatic of a characteristic of designers – especially hardware engineers – that they do not think about such properties of people. Engineers are accustomed to thinking about sizes, shapes, and strengths of things, or how fast they move, but not about their users' cognitive properties (that is, how they perceive and what they know). Further, it seems clear that where such issues *are* addressed, there is a lack of understanding about the limits of people's perceptions and knowledge regarding safety issues associated with products. Assumptions are being made about knowledge and patterns of behavior that the literature on risk perception and accidents would indicate are not warranted. It is not a case of "everybody knows" but, rather, a case of "not everybody knows."

I am not suggesting that such people do not care about the safety of their products and the people who use them. Safety may occasionally bite the dust in the context of cost-benefit analysis, or the line on this trade-off may be drawn at a point that violates our own taste. My concern focuses on the fact that the design is not adequately considering the hazard and risk perceptions and knowledge of people.

WHAT ERGONOMISTS CAN DO

There are no easy formulas or strategies for successfully getting more human factors and ergonomics into the design process. There are at least two dimensions of the problem. First, designers must become more aware of the need to take into account human hazard and risk perceptions and knowledge when designing products. Second, we need to help provide the kind of data, information, and methodologies that will help the design process along.

In the task of increasing designer awareness, we may have some very powerful allies. The first is the government; more specifically, government regulations regarding product and environment safety. Clearly, agencies such as the Occupational Safety and Health Administration, the Food and Drug Administration, and the Consumer Product Safety Commission have brought about changes in the attention given to product and work environment safety among industries and product manufacturers. One can debate the effectiveness of these and other agencies, and one can lament – at least speaking for myself – the gutting such agencies suffered during the

Reagan/Bush years, but it seems clear that they have had some "attentional impact." It also seems to me that these changes have created some opportunities for human factors people to influence the design process regarding safety.

The second ally is litigation. In the United States the litigation process is viewed with varying degrees of support, puzzlement, apprehension, and even distaste. But one conclusion about it seems valid: When it comes to attention to product and environment safety, litigation has had some effect. In the opening chapter of *Handbook of Human Factors*, Julien Christensen wrote:

> *Those who have devoted their professional careers to the human factors/ergonomics movement watch with wonder and awe as the legal profession does through the courts what they have been unable to do*. (1987, p. 6)

Granted, these effects may include a lot more jobs for lawyers in industry. But they may also be creating a climate in which people like us can make some inputs.

Certainly it is possible to make a list of actions we might take and programs we might initiate to influence product design regarding peoples' hazard perceptions and knowledge. Such actions could be educational, including greater efforts to incorporate such information into educational curricula, short courses, and seminars marketed to designers with a need to know, and publications in places where they are likely to be read by designers.

We also have a responsibility to then provide the kind of support that will enable designers to be effective in their efforts. We need to provide guidelines and answers, and generally that means research, both basic and applied. There is a growing body of basic and applied research findings on risk perception that bears on the problem, but there is more to be done. People in the human factors profession are qualified to contribute at both the basic and applied levels of research.

In addition to research, human factors and ergonomics professionals need to be more involved in field testing and marketing testing of products. Manufacturers almost never attempt to assess the target audience's knowledge regarding the use of a product; nor do they assess the effectiveness of their own communication vehicles in terms of educating the user regarding product hazards and risks.

SAFETY PHILOSOPHY

There is a standard approach to dealing with hazards, be they product or environmental hazards that can be found in many published works on safety. It says: first try to design it out. If you cannot, guard; if you cannot, warn. This "design it out/guard/warn" prioritization is most consistent with human factors and ergonomics design philosophies. It has to do with designing things in ways that forgive human limitations and human errors.

I am not suggesting that users' possession of hazard and risk knowledge – either through past experience or through communication – is always the answer. There are potential problems of attention, distraction, and task overload to challenge such solutions. In the design process we need to do our best to determine what safety knowledge requirements exist for the user and whether those requirements are met through the a priori experiences of the user or through safety communications to the user.

These are the kinds of issues that are near and dear to the hearts, guts, and minds of those in the human factors and ergonomics discipline. The growing awareness of and concern for consumer safety is, in my view, providing us both an opportunity and a responsibility. It is a chance to make significant contributions to the safety and well-being of those not always perceptive, not always knowledgeable, but always valued system components that we know as human beings.

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