

The Collaborative Role of Warnings Research and Forensic Investigations

Michael S. Wogalter^a and Kenneth R. Laughery^b

^a*North Carolina State University, Psychology Department, Raleigh, NC 28695-7650 USA*

^b*Rice University, Psychology Department, Houston, TX 77001 USA*

Expert witnesses in the domain of warnings draw heavily on the research literature as a scientific basis for analyses and opinions. This requirement for a scientific basis has in turn resulted in the identification of gaps in the empirical literature and led to research addressing important warnings issues. The warnings research and forensic investigation connection is illustrated by a discussion of three groups of cases: tire failures, product containers, and product manuals. The symbiotic relationship between forensic investigations and warnings research has benefitted both domains.

INTRODUCTION

Warnings are communications intended to convey hazard information, enhance safe behavior, and serve as reminders for purposes of decreasing accidents, injury, illness, and property damage. Much of the warning research has been published in the human factors and ergonomics (HF/E) literature. The considerable growth in warnings research during the last 25 years is indicated by several books on the topic (Edworthy & Adams, 1996; Miller & Lehto, 2001; Wogalter, 2006b; Wogalter, DeJoy, & Laughery, 1999). Also, there have been several recent reviews of the warnings research (e.g., Laughery & Wogalter, 2006; Rogers, Lamson & Rousseau, 2000; Wogalter & Laughery, 2006).

In this article, we take a somewhat different approach from the above-mentioned reviews by focusing on a lesser known instigator of warning research. Some researchers (such as the present authors) have been interested in warnings in part as a result of being involved in the role of expert witness civil litigation (product liability and personal injury claims) in the United States (Askren & Howard, 2005; Noy & Karwowski, 2005).

The primary connection between warning research and HF/E forensic experts is the claim of inadequate warnings in lawsuits. Warnings are part of the interface between humans interacting with products and environments, a central domain of HF/E (Laughery, 2006). According to the U.S. legal system, product manufacturers are obligated to provide warnings and instructions sufficient to permit consumers to use a product safely or to make an informed choice not to use the product (Madden, 1999).

The interchange between warnings and forensics is much more apparent at scientific and

professional HF/E meetings in the U.S. (HFES annual meetings) than in the archival warning research literature. Often when warning research has been initiated either directly or indirectly as a result of issues derived from lawsuits, this impetus of forensics is not indicated in publications based on the research. The main purpose of this article is to describe a few of these connections between warning research and forensics.

Although this article addresses the relationship between warnings research and warnings issues in litigation, it is acknowledged that factors other than expert witness work have played substantial roles in motivating and guiding warnings research. A very important factor is the goal of improving safety. Other warning research has addressed theoretical issues (e.g., Lehto, 2006; Wogalter, 2006a), and some has been applied to specific contexts, such as complex systems development in air defense or transportation. An example of the latter occurred in the late 1990s when on-vehicle warning labels combined with public information campaigns addressed the hazards of children placed in front of vehicle airbags. This warning system resulted in greater public knowledge, fewer children placed in front of airbags, and fewer child fatalities.

Because of the breadth of the warning literature, we limit discussion to warnings presented in the visual modality for product, equipment, and environmental hazards (for example, via labels, signs, product manuals).

Expert testimony is intended to address subject matter generally outside the knowledge domain of the judge and/or jury, the triers of fact. The role of the expert is to educate the judge and/or jury with regard to information beyond their "common sense" or personal experience. The role of

the HF/E expert in a warnings case includes evaluating and giving opinions regarding a number of issues, including the following (Laughery & Wogalter, 2005): Is a warning needed? Is an existing warning or warning system adequate? What would an adequate warning system be? Would an adequate warning system make a difference? The expert assembles literature pertinent to these issues, reviews the facts of the case, and formulates opinions.

In a failure-to-warn claim, the plaintiff's proof must establish causation. In its most elementary form, such proof will show, for example, that if the product seller had supplied an adequate warning, the injured claimant would have avoided injury. The evidence must support a reasonable inference, rather than a guess, that the existence of an adequate warning might have prevented the accident. A defendant may argue that even with an adequate warning, the plaintiff would have acted in the same way and would have suffered the injury. There is, of course, usually much more to the claims and the particulars than this very simplified description of opposing positions. The warning expert's role is to aid the court in making decisions.

EXPERT WITNESS AND WARNINGS RESEARCH

There are at least three reasons why an HF/E warning expert in the legal setting may (or should) be interested and active in warning research. First, to be accepted and to perform as an expert, one must be knowledgeable about the subject matter. This knowledge includes an appreciation and understanding of theory, methodology, content, and the current research literature.

A second reason for the expert's involvement in research concerns the adversarial nature of the litigation context. The expert can expect to be questioned about the subject matter before being permitted to give opinions. Knowing the literature plays an important role. Having authored relevant publications adds to the likelihood of being permitted to testify to the triers of fact.

A third reason for the warning expert's interest in warning research literature is that the scientific knowledge, as reflected in the research literature, serves as the basis for the expert's opinions. Again, given the adversarial setting, the expert can expect to be challenged when providing analyses and opinions regarding warning issues.

As a result of increasing involvement of HF/E experts in litigation, researchable questions have been identified and empirical research conducted. Furthermore, the need for a research basis in expert

opinion was strongly influenced by an early 1990's U.S. Supreme Court decision. This was the Daubert case (Daubert v. Merrell Dow Pharmaceuticals, Inc., 1993; Papinchock & Landy, 2005), which affected the role of expert witness in the U.S. Federal Court system. As noted earlier, expert testimony concerns information outside the knowledge domain of the triers of fact (the judge and/or jury). The Daubert decision was intended to prevent the trier of fact from even hearing expert testimony that lacks scientific foundation. In short, the U.S. Supreme Court decision required that expert opinion have a scientific basis and gave several criteria for U.S. Federal Courts to employ in determining whether there is an adequate scientific basis for an expert's opinions. One of the criteria was whether the opinions are based on evidence contained in peer-reviewed publications. This ties into having quality relevant research available on warning issues in order to pass a Daubert challenge so as to be able to present evidence and give opinions.

EXAMPLES OF LITIGATION INFLUENCING WARNINGS RESEARCH

We have thus far posited the notion that forensic investigations in the litigation context have suggested ideas for warning research. Three brief examples of how the litigation context has influenced warning research are described: tire failure, chemical poisoning and product manuals.

Tire Failure

The first example of cases involves tire failure. Lawsuits have been filed in the U.S. pertaining to injury and death that resulted from tire failure and a subsequent vehicular crash. In one case, tire failure was attributed to a tire being too old and failing even though the tires had hardly or never been used; in other words, there was plenty of tire tread remaining and the tire was adequately pressurized. Evidence in case revealed that tire manufacturers add anti-aging components to tires to avoid inevitable breakdown of the rubber compounds; however, the tires need to be used in order for the anti-aging components to work. Discovery established that tire manufacturer knew about aged tires being hazardous, but provided no direct information about the issue for public consumption. In other words, the manufacturer provided no warnings. That might be okay if consumers are aware that older tires could be hazardous or that the hazard was "open and obvious" (i.e., the consumers could easily realize when a tire is getting too old and unsafe. However,

research (Cowley, Kim, & Wogalter, 2006; Kalsher, Wogalter, Lim, & Laughery, 2005) indicates that many people are not aware that tire aging is a potential problem.

Another kind of tire failure illustrates the next case. Here two persons were severely injured in a crash shortly after having two new tires installed on the front of their vehicle by a local tire retailer. Accident investigation concluded that there had been water on the road, the vehicle probably hydroplaned, the driver lost control, and the vehicle, rolled over. Discovery also revealed that the manufacturer knew from systematic testing that two new tires (best tread) should always be put on the rear, not on the front. The reason is that if the rear tires lose traction before the front tires, the vehicle is almost impossible to control (control is more likely if the front tires lose traction first). Discovery also revealed that the manufacturer had assisted one major tire seller with materials (such as a video and brochures), but had not provided those materials or informed other dealers about the hazard (except in an obscure location in the manufacturer's fitment guide). Thus, not only were most consumers not informed, the dealer who had mounted the tires on the subject vehicle had not been informed (warned). Subsequent research revealed that most consumers do not know about the two-tire rule (Smith, Cowley & Wogalter, 2008).

These tire failure cases and the subsequent research indicate that people do not know tire aging and improper placement of two new tires may be a safety problem that could cause crashes. There had been no previous research or testing of consumers on what they know about tires. The forensic analyses and research that followed suggested that adequate warning pertaining to tire safety was not being conveyed, and a much better warning system is needed with regard to communicating hazards associated with tires.

Product Containers

The second group of cases involves perceptions of product containers. In one case, a utility lineman after work consumed a bottle of fortified wine (40 proof or 20% alcohol). He stated later that he had thought the wine had a minimal amount of alcohol and more specifically thought it had the strength of a wine cooler. He had gotten this impression because it was "berry" flavored and it was bottled in a contemporary bottle like that of wine coolers. He also he had never consumed the beverage before, and it was purchased by a co-worker at a convenience store. On his way home after drinking the wine, the utility worker hit a

motorcycle causing amputation and brain injuries to the operator and passenger. Labeling was not an issue in the case as it met all of the Federal requirements and the warning claim was precluded. The issue became the appearance of the bottle and whether the container connoted less hazard than it was. In settling the case, the product manufacturer agreed to change the shape of the bottle. The new shape gave it a stronger connotation of hazard.

In another case, a maintenance employee had not fully read a paint-can label before applying paint to the bottom of an emptied, dry, in-ground pool. There was a lot of fine print and he thought he knew how to use the paint. Shortly after using it, he was overcome by the vapors (which were heavier than air and did not dissipate). The pool paint contained toluene and xylene, chemicals that are sensitizers and known to cause brain damage. He was found later in the day having a series of epileptic attacks at a park several blocks away.

Subsequent research by Wogalter, Laughery, & Barfield (1997) has shown that container shape and other features of design can influence perceived hazardousness of the contents. Container shapes associated with safer products may not cue adequate levels of hazardousness to prompt reading the label. In each of the above cases, injury resulted from having made assumptions about the container contents without having read the label. Given that people may not read the labels, cues for hazards might be communicated via nonverbal techniques, including the shape of containers.

Operator's Manuals

The third set of cases involves safety communications via product manuals. Numerous cases in the litigation setting have revealed to HF/E warning experts that people do not always read the manual for a product, and that information was missed that could have prevented a subsequent injury. While one might immediately think to blame the injured person for not reading the manual, sometimes the injured party was not the owner or operator, and sometimes there was no opportunity to read the manual. Consider one case in which a woman passenger in a rental car reclined her seat on a long trip, and then an accident resulted in a broken neck when she was partially ejected. The owner's manual for the vehicle states that the seat shall not be reclined when moving. The manufacturer did not have a good warning since it lacked consequences and explicit reasons for this rule, and it only appeared embedded into a manual consisting of hundreds of pages. Few actual owners of the vehicle might see the warning, and even fewer

renters and their passengers are likely to read it. Sometimes the owner's manual is not even provided in rental vehicles. Research (e.g., Mehlenbacher, Wogalter & Laughery, 2002; Wogalter, Vigilante, & Baneth, 1998) on owner's manuals have revealed that: (a) people frequently do not get the manual with resold (used) products; (b) if they get one, they tend to read only sections of the manual in order to solve a problem; and, (c) only about 5% vehicle owners report reading their manual completely. Clearly, there is a need to enhance safety communications beyond the manual if people are to get necessary warnings. Future warning systems will likely use flat panel type screens on the dash panels. A sticker or a black panel light on the dash could provide the warning not to recline when the vehicle is in motion. Of course, a more reliable method in the rental car instance would be to disable the seat recline, or to design the system to restrain people adequately when they are in a reclined position.

SUMMARY

The increasing role of the expert witness in warnings issues in civil litigation over the last several decades has resulted in HF/E warning expert drawing heavily on the research literature as a scientific basis for analyses and opinions. This requirement for a scientific basis has in turn resulted in the identification of gaps in the research literature and led to research spanning a wide range of warning design and effectiveness issues. The cases themselves can sometime initiate new ideas and drive research. The interaction between the expert role and warnings research has contributed to the research progress. Three sets of examples were presented here. Other examples of factors that have been identified and studied in the research literature include conspicuity, use of pictorials, cost of compliance, familiarity, and social modeling.

The benefits of this symbiotic interaction have been threefold. First, by extending our knowledge and understanding of warning system design and effectiveness, it has contributed to the potential for warnings to be effective in improving product and environmental safety. Second, it has enabled HF/E specialists to better fulfill their role as warning experts in civil litigation. Third, the research feeds on theory and model building about human perceptual and cognitive abilities. Due to the unique influence of litigation, the research literature would be less developed than without it.

REFERENCES

- Askren, W. B., & Howard, J. M. (2005). A road map for the practice of forensic human factors and ergonomics. In I. Y. Noy & W. Karwowski (Eds.), *Handbook of human factors in litigation* (pp. 5.1–5.16). Boca Raton, FL: CRC Press.
- Daubert v. Merrell Dow Pharmaceuticals, Inc., 951 F.2d 1128 (9th Cir. 1991), vacated, 113 S.Ct.2786 (1993).
- Edworthy, J. & Adams, A. (1996), *Warning design: A research prospective*. London: Taylor & Francis.
- Laughery, K. R. (2006). Safety communications: Warnings. *Applied Ergonomics*, 37, 467–478.
- Laughery, K. R., & Wogalter, M. S. (2005). The warning expert. In I. Y. Noy & W. Karwowski (Eds.), *Handbook of human factors in litigation* (pp. 30.1–30.14). Boca Raton, FL: CRC Press.
- Laughery, K. R., & Wogalter, M. S. (2006). Designing effective warnings. In R. C. Williges (Ed.), *Reviews of human factors and ergonomics* (pp. 241–271). Santa Monica, CA: Human Factors and Ergonomics Society.
- Lehto, M. R. (2006). Optimal warnings: An information and decision theoretic perspective. In M. S. Wogalter (Ed.), *Handbook of warnings* (pp. 89–108). Mahwah, NJ: Erlbaum.
- Madden, M. S. (1999). The law relating to warnings. In M. S. Wogalter, D. M. DeJoy, & K. R. Laughery (Eds.), *Warnings and risk communication* (pp. 315–330). London: Taylor & Francis.
- Miller, J. M., & Lehto, M. R. (2001). *Warnings and safety instructions: An annotated bibliography* (4th ed.). Ann Arbor, MI: Fuller Technical Publications.
- Noy, I. Y., & Karwowski, W. (Eds.). (2005). *Handbook of human factors in litigation*. Boca Raton, FL: CRC Press.
- Papinchock, J. M., & Landy, F. J. (2005). The influence of Daubert on expert witness testimony: The human factors context. In I. Y. Noy & W. Karwowski (Eds.), *Handbook of human factors in litigation* (pp. 7.1–7.12). Boca Raton, FL: CRC Press.
- Rogers, W. A., Lamson, N., & Rousseau, G. K. (2000). Warning research: An integrative perspective. *Human Factors*, 42, 102–139.
- Wogalter, M. S. (2006a). Communication-human information processing (C-HIP) model. In M.

- S. Wogalter (Ed.), *Handbook of warnings* (pp. 51–61). Mahwah, NJ: Erlbaum.
- Wogalter, M. S. (Ed.). (2006b). *Handbook of warnings*. Mahwah, NJ: Erlbaum.
- Wogalter, M.S., DeJoy, D. M. & Laughery, K. R. (Eds.), *Warnings and risk communication*. London: Taylor & Francis.
- Wogalter, M. S., & Laughery, K. R. (2006). Warnings and hazard communications. In G. Salvendy (Ed.), *Handbook of human factors/ergonomics* (3rd ed., pp. 889–911). New York: Wiley.