C8 Human Factors Evaluation of a Steam Shower

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After attending this presentation, attendees will gain an understanding of the process involved in conducting original research as part of a forensic human factors investigation as well as insight into how to evaluate the psychological or human factors that often interact with engineering issues.

This presentation will impact the forensic community and/or humanity by demonstrating an approach to evaluate issues that cannot be addressed using standard site inspection and laboratory techniques.

The authors present a case to demonstrate the use of original research to evaluate behavioral expectations of product users. Due to diabetes, Plaintiff has peripheral neuropathy (he has no feeling in his legs and feet). He took a steam shower in a hotel suite designated for people with disabil- ities. Prior to using the shower, Plaintiff noticed a vent on the wall that said "THERASTEAM" (name of company has been changed) in large letters covering the entire face of the plate. After using the steam shower, Plaintiff's leg turned red, became infected, and did not heal due to his dia- betes. He ultimately had to have his leg amputated. How did this accident happen? What human factors engineering issues were causal factors? This presentation will explore the design of the steam shower, control devices, installation instructions, warnings, and behavioral expectations of the users.

The steam shower was controlled by two knobs labeled "time" and "temperature." Around the knobs, there were four hatch marks that were not labeled to indicate calibration. The temperature control, according to the Owner's Manual, was designed to be in increments of 107^{O}, 116^{O}, 124^{O} and 130^{O} F. The controls were installed in the suite kitchen, far removed from the steam shower. To use the shower, the user had to turn the timer knob, go past the kitchenette, through the restroom, and through a glass door to the steam shower.

In front of the bench seat is a steam outlet pipe (see Figure 1), approx- imately 12" above the floor and 18" from the seat. On the wall perpen- dicular to the seat (approximately 4 feet from the seat) was the thermostat vent (see Figure 2) located six feet high with "THERASTEAM" embossed across the front.

Plaintiff contended that the thermostat vent was the steam outlet. In actuality, the outlet pipe projected from the wall opposite the bench. The Owner's manual instructed, "Install steam head [outlet pipe] 18" above shower floor. The steam head should be located as far from the seating area as possible *for bather's comfort.*" No written warning described the safety hazard to the user if the steam head was installed near the seating area.

Plaintiff contended that the steam shower device was unsafely designed, improperly installed, and did not have effective warnings. Defense contended that Plaintiff was aware of his disability and should have taken better care to protect himself. They also contended that Plaintiff was inattentive since he failed to properly detect the source of the steam (steam could not be felt due to the Plaintiff's neuropathy).

A human factors evaluation of the system must take into account the both the device and users. An inspection of the shower while in operation indicated that the tile surface caused a reverberation which made it difficult to auditorily locate the steam source. Moreover, once a little steam entered the room, its source could not be visually identified.

In order to evaluate the user interface and perceptions, a study was conducted using photographs of the controls and shower components. Since Defense contended that Plaintiff was not reasonable in his failure to identify the steam outlet pipe, the authors tested 24 other people's percep- tions. This study evaluated how people unfamiliar with the steam shower would interpret the components. Participants were first asked to estimate the time and temperature settings of controls as depicted in a photograph. While study participants were reasonably accurate with the time setting, no one was able to determine the temperature (responses ranged from 60^{O} to 105^{O}).

To evaluate the reasonableness of Plaintiff's belief that the thermostat sensor was the steam outlet, participants were asked to refer to photographs and identify the thermostat vent ("Please tell me what this object [pointing] is"), steam outlet pipe, and several items used as distracters (bench, shower hose, and handrail). Consistent with Plaintiff's perception, 88% of the study participants also misidentified the thermostat vent as the steam outlet while only 8% recognized it as a thermostat or sensor. Similarly, 8% of the participants correctly identified the steam outlet pipe.

The authors use this case study to illustrate the practical application of employing human factors research in evaluating reasonableness of conduct and product users' perceptions.

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Figure 1. Steam shower seat area (outlet pipe indicated)

Figure 2. Thermostat vent Human Factors, Perceptions, User Interface

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