IDENTIFICATION OF AN "APPROPRIATE" DROWSY DRIVER DETECTION INTERFACE FOR COMMERCIAL VEHICLE OPERATIONS

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Considerable progress has been made in measuring drowsiness and understanding its effects upon human performance in the laboratory and in simulated and operational driving conditions. This work builds upon previous research and identifies an appropriate design for a drowsy driver detection interface. A participatory design process was used that included both design experts and drivers in separate focus groups. One expert activity, evaluations of candidate interaction flow models, and two driver activities, critical incident interviews and a design exercise, are described here. The conflict that arose between the drivers' desires and the desires of the scientific community is that the drivers viewed the system as a loyal servant that would alert the driver when he became drowsy, while the scientific community viewed the system as a trusted advisor that would encourage the driver to stop and rest. The final design has many features to address both of these views.

INTRODUCTION

Driver drowsiness poses a major threat to roadway safety and the problem is particularly severe for commercial motor vehicle (CMV) drivers. Drowsy driver crashes cost $12 billion and contribute to up to 35% of the 4,400 annual truck driver deaths (FHWA, 1998). Fatigued drivers are often unaware of their condition, frequently driving for 3-30 seconds with their eyes closed. Twenty-four hour operations, high annual mileage, exposure to demanding environmental conditions and demanding work schedules make drowsiness a major cause of combination-unit truck (CUT) crashes.

Considerable progress has been made in measuring drowsiness and understanding its effects upon human performance in the laboratory and in simulated and operational driving conditions. Wierwille, et al (1994) generated a measure of drowsiness, PERCLOS, associated with degradation in driving performance in a simulated roadway environment. Experimental studies performed by Dinges, et al (1998) to test the validity of PERCLOS and other new technologies for drowsiness detection showed that PERCLOS was able to accurately predict fatigue-induced lapses in vigilance. Studies by Grace, et al (1999) of overnight commercial trucking operations have produced a real-time monitor capable of detecting driver drowsiness in an operational setting. Furthermore, this monitor used in conjunction with a driver feedback system has been shown to decrease drowsiness and improve driver performance in simulated driving conditions (Mallis et al, 2000). These advances, for the first time, make accurate detection and management of drowsiness feasible.

The main question to the driver is which of the driving time countermeasures and rest time countermeasures are desirable, practical and/or useful. It is known that countermeasures other than sleep may be ineffective or effective for only short periods of time (Mallis et al, 2000). Despite this, anecdotes or myths about personal habits may instill drivers with false confidence about the effectiveness of their personal method. It is also common knowledge within the scientific community (Dinges, 1989; Wylie, 1996; Brown, 1997) that self-assessment of drowsiness is unreliable. A driver may decide to disregard the warning from the feedback system based on his/her own perception.

User-centered interfaces and corresponding interactions for warning systems should enable drivers to understand the severity of the warning and adjust their behavior accordingly. As such, a major research question for this effort was:

- What is the most appropriate design for a drowsy driver detection interface?

In particular, drivers need accurate, reliable information that highlights their condition without providing them with encouragement to extend unsafe behavior or contributing to the perception that repeated warnings are a substitute for sound judgment. Modification of behavior with safer choices should reduce the frequency of highly fatigued periods, and lead to a decrease in potential incidents.

DESIGN APPROACH

The design process was organized around humanistic themes (human connection, choice, engagement, integration, driver awareness, and association) that emerged from gaps identified in past approaches. These themes set the tone for the designs.

With user-centered design principles (Jordan, 1998) central to the development, the team undertook a series of activities to enhance their understanding of the problem space and assist in the development of an appropriate design. These included literature reviews, brainstorming sessions, field visits, and thematic explorations that culminated in an expert/advisor focus group and a user focus group.