Investigating nurses' preference for drowsy driving mitigation technologies

Alec Smith[1], Anthony McDonald[1], Farzan Sasangohar[1,2]
[1]Industrial and Systems Engineering, Texas A&M University, College Station, TX
[2]Center for Outcomes Research, Houston Methodist, Houston, TX

Drowsy driving is a serious problem that claims the lives of many every year. Between 2011 and 2015, over 160,000 injuries and 3,600 deaths were attributed to drowsy driving (National Center for Statistics and Analysis, 2017). These numbers are likely underestimated due to the lack of physical evidence after a crash (Akerstedt, 2000). To address this problem, there exists a clear need for effective drowsy driving mitigation techniques such as public policy, education and drowsy driving technologies (Higgins et al., 2017). Although a variety of drowsy driving mitigation technologies exist, are not widely accepted, which is vital for adoption and effectiveness.

Shift workers are at particularly greater risk of being involved in a drowsy driving crash than the general public (National Sleep Foundation, 2019). Similarly, medical professionals working the shift schedule are at a greater risk of drowsy driving compared to the general population (Barger et al., 2005). Nurses often experience drowsiness during their work, which can carry over to their drive home (Caruso & Hitchcock, 2010). Further, the proportion of drowsy driving among nurses is high with 79% in 2007 (Scott et al., 2007). Nurses are a unique population with a specific background and training that tends towards specific requirements for a technological intervention (Khanade, Sasangohar, Sutherland, & Alexander, 2018). Understanding the background and training of the nurses can lead to additional design requirements for drowsy driving technology that if satisfied, will improve its acceptance and appropriate use.

We conducted semi-structured interviews with 30 night-shift nurses to understand their preferences for a in-vehicle drowsy driving mitigation device. Questions covered topics such as expectations for a drowsy driving mitigation device, preferred feedback types and feelings of security and privacy with the mitigation device. The interviews were recorded for transcription and analysis. The transcripts were analyzed using a thematic analysis where quotes were organized by codes and themes were identified from the data (Braun & Clarke, 2006; Guest et al., 2011).

When asked to provide general wants and desires for drowsy driving technology, the nurses mentioned many existing technologies such as lane departure warnings, fatigue-monitoring devices and an alert or stimulation to wake them up. Overall, nurses found a drowsy detection device to be acceptable and they believed that a video monitoring system would be acceptable as long as it was effective in mitigating their drowsiness.

Nurses preferred three main forms of feedback from a technological device: audio, tactile and visual. Auditory feedback was the most preferred form of feedback among the nurses. Within this category, participants thought that loud audio, music, or some sort of voice feedback could be used to alert them of their drowsiness. Tactile feedback was preferred by many nurses, especially in the form of a vibration from a phone or smart watch. However, some nurses thought that a tactile sensation could be confused for a vehicle malfunction. Visual feedback was not preferred as much as the auditory or tactile feedback because some nurses thought that if their eyes were closing due to drowsiness, they would not be able to see the alert. Of those that did prefer a visual alert, the nurses mentioned having a notification or light on their dashboard or in their line of sight.

While these feedback types could be used individually, they can be combined for different purposes: audio or tactile feedback can alert the driver of their drowsiness, while a visual notification can direct the driver to take specific actions. Previous work has shown the effectiveness of combining different feedback types in experimental driving (Gaspar et al., 2017) and healthcare (Ferris & Sarter, 2008) domains. Each of these types of feedback can be taken into account when designing or selecting a drowsy driving detection and mitigation device.

These findings are specific to night-shift nurses and it is important that the tools they use fit their needs and take into account their expectations. However, due to some of the contextual similarities of shiftwork, these responses can be used to help in the initial design or investigation of drowsy driving mitigation devices for other shift workers.

REFERENCES

Akerstedt, T. (2000). Consensus statement: fatigue and accidents in transport operations. *Journal of Sleep Research*, *9*(4), 395.

Barger, L. K., Cade, B. E., Ayas, N. T., Cronin, J. W., Rosner, B., Speizer, F. E., & Czeisler, C. A. (2005). Extended work shifts and the risk of motor vehicle crashes among interns. *New England Journal of Medicine*, *352*(2), 125–134.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Caruso, C. C., & Hitchcock, E. M. (2010). Strategies for nurses to prevent sleep-related injuries and errors. *Rehabilitation Nursing*, *35*(5), 192–197.

Dawson, D., Reynolds, A. C., Van Dongen, H. P. A., & Thomas, M. J. W. (2018). Determining the likelihood that fatigue was present in a road accident: a theoretical review and suggested accident taxonomy. *Sleep Medicine Reviews*, *42*, 202–210.

Ferris, T., & Sarter, N. B. (2008). Cross-modal links among vision, audition, and touch in complex environments. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *50*(1), 17–26.

Gaspar, J. G., Brown, T. L., Schwarz, C. W., Lee, J. D., Kang, J., & Higgins, J. S. (2017). Evaluating driver drowsiness countermeasures. *Traffic Injury Prevention*, *18*(sup1), S58–S63.

Guest, G., MacQueen, K. M., & Namey, E. E. (2011). *Applied thematic analysis*. Washington, DC: Sage Publications.

Higgins, J. S., Michael, J., Austin, R., Akerstedt, T., Van Dongen, H. P. A., Watson, N., Rosekind, M. R. (2017). Asleep at the wheel—The road to addressing drowsy driving. *Sleep*, *40*(2), 1-9.

Khanade, K., Sasangohar, F., Sutherland, S. C., & Alexander, K. E. (2018).

Deriving information requirements for a smart nursing system for intensive care units. *Critical Care Nursing Quarterly*, *41*(1), 29–37.

National Center for Statistics and Analysis. (2017). *Drowsy Driving 2015 (Crash•Stats Brief Statistical Summary. Report No. DOT HS 812 446)*. Washington, DC: Author.

National Sleep Foundation. (2019). Drowsy Driving Facts and Stats. Retrieved from http://drowsydriving.org/about/facts-and-stats/

Scott, L. D., Hwang, W.-T., Rogers, A. E., Nysse, T., Dean, G. E., & Dinges, D. F. (2007). The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep*, *30*(12), 1801–1807.