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Atchley, Paul; Chan, Mark. *Potential Benefits and Costs of Concurrent Task Engagement to Maintain Vigilance : a Driving Simulator Investigation*. S. 3-12(10).

Objective: The objective of this study was to investigate the nature of concurrent task interference during a vigilance task and to determine whether a concurrent task improves performance with decreased vigilance. **Background:** Research has repeatedly shown that engaging in a cell phone conversation while driving increases the risk of getting into crashes. At the same time, it has also been found that task monotony could lead to an increase in crash risk. There is evidence that suggests that engaging in a concurrent task reduces the effects of monotony, leading to an improvement in vigilance task performance. **Method:** A monotonous drive in a driving simulator was used to investigate the effects of a concurrent verbal task. Three task conditions were used: no verbal task, continuous verbal task, and late verbal task. **Results:** When engaged in a secondary verbal task, drivers showed improved lane-keeping performance and steering control when vigilance was lowest. **Conclusion:** A strategically placed concurrent task can improve performance when vigilance is at its lowest. **Application:** There is potential for the design of a countermeasure system that can be strategically activated by an automated system monitoring driver performance.

- **Keywords:** COUNTERMEASURES; VIGILANCE; MONO TONY; CONCURRENT TASK; LANE-KEEPING PERFORMANCE; DRIVER SAFETY

He, Jibo; Becic, Ensar; Lee, Yi-Ching; Jason, S.; McCarley, Jason S. *Mind Wandering Behind the Wheel: Performance and Oculomotor Correlates*. S. 13-21(9).

Objective: An experiment studied the frequency and correlates of driver mind wandering. **Background:** Driver mind wandering is associated with risk for crash involvement. The present experiment examined the performance and attentional changes by which this effect might occur. **Method:** Participants performed a car-following task in a high-fidelity driving simulator and were asked to report any time they caught themselves mind wandering. Vehicle control and eye movement data were recorded. **Results:** As compared with their attentive performance, participants showed few deficits in vehicle control while mind wandering but tended to focus visual attention narrowly on the road ahead. **Conclusion:** Data suggest that mind wandering can engender a failure to monitor the environment while driving. **Application:** Results identify behavioral correlates and potential risks of mind wandering that might enable efforts to detect and mitigate driver inattention.

- **Keywords:** DRIVER BEHAVIOR; MIND WANDERING; ATTENTION; DISTRACTION; EYE MOVEMENTS

Pastel, Robert. *Positioning Graphical Objects on Computer Screens : a Three-Phase Model*. S. 22-37(16).

Objective: This experiment identifies and models phases during the positioning of graphical objects (called cursors in this article) on computer displays. **Background:** The human computer-interaction community has traditionally used Fitts' law to model selection in graphical user interfaces, whereas human factors experiments have found the single-component Fitts' law inadequate to model positioning of real objects. **Method:** Participants ($N = 145$) repeatedly positioned variably sized square cursors within variably sized rectangular targets using computer mice. The times for the cursor to just touch the target, for the cursor to enter the target, and for participants to indicate positioning completion were observed. The positioning tolerances were varied from very precise and difficult to imprecise and easy. **Results:** The time for the cursor to touch the target was proportional to the initial cursor-target distance. The time for the cursor to completely enter the target after touching was proportional to the logarithms of cursor size divided by target tolerances. The time for participants to indicate positioning after entering was inversely proportional to the tolerance. **Conclusions:** A three-phase model defined by regions—distant, proximate, and inside the target— was proposed and could model the positioning tasks. **Applications:** The three-phase model provides a framework for ergonomists to evaluate new positioning techniques and can explain their deficiencies. The model provides a means to analyze tasks and enhance interaction during positioning.

- **Keywords:** FITTS' LAW; PIÉRON'S LAW; MOUSE POINTING; MOUSE SELECTIONS

Benden, Mark E.; Fink, Rainer; Congleton, Jerome. *An In Situ Study of the Habits of Users That Affect Office Chair Design and Testing*. S. 38-49(12).

Objective: The purpose of this study was to perform an in situ assessment of office seating habits that influence chair testing and design. **Background:** Many chair testing parameters were derived decades ago when the average weight of people within the United States was dramatically lower and the office work tasks less computer based. **Method:** For the study, 51 participants were randomly selected from Brazos Valley, Texas, businesses to participate in 8-hr assessments of office seating habits. Overall results were compared with current chair testing and design assumptions. Data were collected through written survey and through data logging of seat and back contact pressure and duration with the use of the X-SENSOR™ pressure mapping device and software. Additionally, 1 day per participant of caster roll distance was recorded with the use of a caster mounted digital encoder. Participants were grouped by body mass index (BMI) and weight (BMI <35 and weight <102 kg or BMI >35 and weight >102 kg). **Results:** It was determined that a significant difference did exist between the groups in mean seat time per shift ($p < .001$), back cycles per shift ($p < .002$), seat cycles per shift ($p < .01$), and caster distance rolled per shift ($p < .001$). **Conclusion:** Several key parameters and assumptions of current chair test methods and design specifications may no longer be valid for the upper quartile of weight range of the current U.S. population. **Application:** The data collected in this study will enable engineers to determine whether revision of design standards for testing office seating for both normal weight and extremely obese workers is indicated.

- **Keywords:** BIOMECHANICS; ANTHROPOMETRY; WORK PHYSIOLOGY; OFFICE SEATING; BODY MASS INDEX; CHAIR DESIGN; CHAIR TESTING

de Groot, Stefan; de Winter, Joost C.F.; García, José Manuel López; Mulder, Max; Wieringa, Peter A. *The Effect of Concurrent Bandwidth*

Feedback on Learning the Lane-Keeping Task in a Driving Simulator. S. 50-62(13).

Objective: The aim of this study was to investigate whether concurrent bandwidth feedback improves learning of the lane-keeping task in a driving simulator. **Background:** Previous research suggests that bandwidth feedback improves learning and that off-target feedback is superior to on-target feedback. This study aimed to extend these findings for the lane-keeping task. **Method:** Participants without a driver's license drove five 8-min lane-keeping sessions in a driver training simulator: three practice sessions, an immediate retention session, and a delayed retention session 1 day later. There were four experimental groups ($n = 15$ per group): (a) on-target, receiving seat vibrations when the center of the car was within 0.5 m of the lane center; (b) off-target, receiving seat vibrations when the center of the car was more than 0.5 m away from the lane center; (c) control, receiving no vibrations; and (d) realistic, receiving seat vibrations depending on engine speed. During retention, all groups were provided with the realistic vibrations. **Results:** During practice, on-target and off-target groups had better lane-keeping performance than the nonaugmented groups, but this difference diminished in the retention phase. Furthermore, during late practice and retention, the off-target group outperformed the on-target group. The off-target group had a higher rate of steering reversal and higher steering entropy than the nonaugmented groups, whereas no clear group differences were found regarding mean speed, mental workload, or self-reported measures. **Conclusion:** Off-target feedback is superior to on-target feedback for learning the lane-keeping task. **Application:** This research provides knowledge to researchers and designers of training systems about the value of feedback in simulator-based training of vehicular control.

- **Keywords:** AUGMENTED FEEDBACK; OFF- AND ON-TARGET FEEDBACK; TRACKING TASK; DRIVER TRAINING; SKILL DEVELOPMENT; TACTILE DISPLAY

Gray, Rob. Looming Auditory Collision Warnings for Driving. S. 63-74(12).

Objective: A driving simulator was used to compare the effectiveness of increasing intensity (looming) auditory warning signals with other types of auditory warnings. **Background:** Auditory warnings have been shown to speed driver reaction time in rear-end collision situations; however, it is not clear which type of signal is the most effective. Although verbal and symbolic (e.g., a car horn) warnings have faster response times than abstract warnings, they often lead to more response errors. **Method:** Participants ($N = 20$) experienced four nonlooming auditory warnings (constant intensity, pulsed, ramped, and car horn), three looming auditory warnings ("veridical," "early," and "late"), and a no-warning condition. In 80% of the trials, warnings were activated when a critical response was required, and in 20% of the trials, the warnings were false alarms. For the early (late) looming warnings, the rate of change of intensity signaled a time to collision (TTC) that was shorter (longer) than the actual TTC . **Results:** Veridical looming and car horn warnings had significantly faster brake reaction times (BRT) compared with the other nonlooming warnings (by 80 to 160 ms). However, the number of braking responses in false alarm conditions was significantly greater for the car horn. BRT increased significantly and systematically as the TTC signaled by the looming warning was changed from early to veridical to late. **Conclusion:** Looming auditory warnings produce the best combination of response speed and accuracy. **Application:** The results indicate that looming auditory warnings can be used to effectively warn a driver about an impending collision.

- **Keywords:** AUDITORY DISPLAYS; DRIVER BEHAVIOR; REACTION TIME; HIGHWAY AND VEHICLE DESIGN; AUDITION; DETECTION

Morgan, Justin F.; Hancock, Peter A. *The Effect of Prior Task Loading on Mental Workload : an Example of Hysteresis in Driving*. S. 75-86(12).

Objective: This study examined how transitions in task demand during a driving and navigation task manifested themselves as delayed adaptation in driver mental workload.

Background: A delayed reaction to changes in demand levels, termed *hysteresis*, has been identified in a number of settings. However, little research has specifically examined the driving task for hysteresis effects. **Method:** A total of 32 drivers completed drives while using a navigation system that would fail within the drive. Subjective mental workload was recorded prior to and following system failure as well as at the conclusion of the drive. **Results:** Results indicated that a gradual reduction in overall mental workload across trials and a lagged recovery to reduction in task demand was present within trials. Analysis of the mental workload subscales within trials indicated that this effect was produced by the mental effort component of workload. **Conclusion:** A moderate hysteresis effect is present in mental workload transitions within the driving task. Although subjective mental workload decreases across trials, the magnitude of the lagged recovery within trials remains unchanged. **Application:** Scaling of in-vehicle information is beneficial with respect to driver mental workload. Display and communication technologies designers should consider not only the immediate task demand but also the driver's task demand history when determining what and how to provide information.

- **Keywords:** MENTAL WORKLOAD; STRESS; WORKLOAD TRANSITIONS; DRIVING SIMULATION; DRIVER PERFORMANCE; HYSTERESIS