

Liberty Mutual Research Institute for Safety

Calibration and Distracted Driving: Findings and Framework

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2nd International Conference on Driver Distraction and Inattention
Sept 5-7 2011

Liberty Mutual Research Institute for Safety

generating knowledge to help people live safer and more secure lives



Mission:
to advance scientific, business-
relevant knowledge in
workplace and highway safety,
and work disability

- Center for Injury Epidemiology
- Center for Physical Ergonomics
- Center for Behavioral Sciences
- Center for Disability Research



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Take Away Points

- Need better understanding of precursors or upstream factors related to distraction
 - ◆ Driver awareness of own performance while distracted
- Calibration is broadly defined
 - ◆ Need to be clear when describing construct
 - ◆ Relevance and implications at different levels of driving task
- Lens model can be applied in this context
- Preliminary framework for studying calibration

Distraction

- Driver distraction and inattention
 - ◆ Lots of press, discussion and research
 - ◆ Number of portable and embedded devices and technologies on the rise
- Performance decrements have been a focus of much previous research, but other aspects of distraction less well-understood:
 - ◆ Precursors to distraction / upstream factors
 - ◆ Willingness and decisions to engage in distracting activities
 - ◆ Some useful frameworks (Lerner & Boyd, 2005; Lee & Strayer, 2004; others)
 - ◆ Drivers' awareness of **own** distraction effects (i.e., performance decrements)



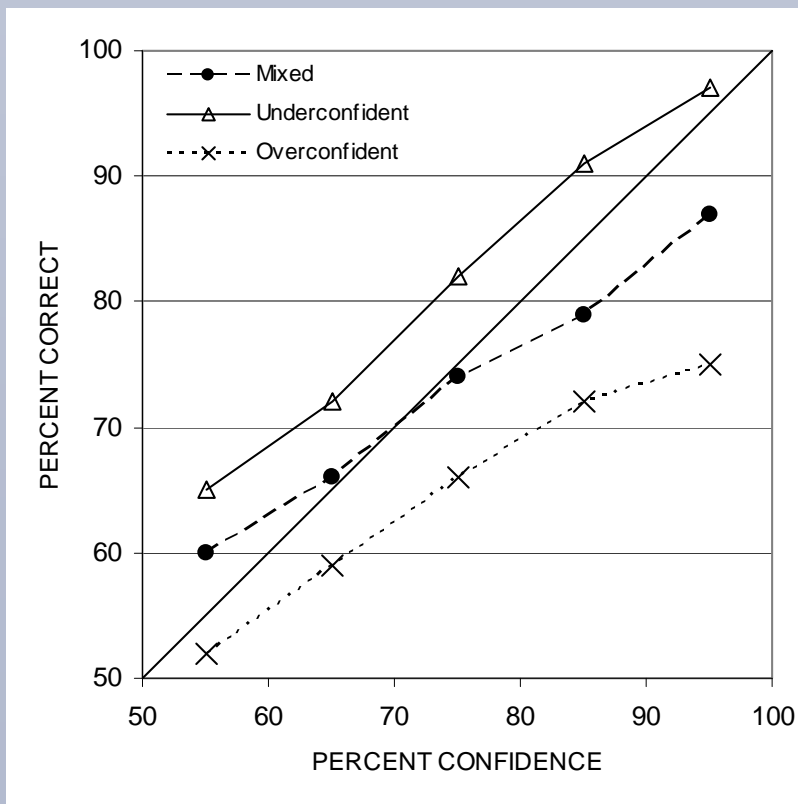
Drivers' awareness of distraction effects

- Lesch & Hancock (2004)
 - ◆ Confidence in dealing with distraction not related to actual performance while distraction
 - ◆ No relationship between subjective ratings of performance and actual performance
- Horrey, Lesch & Garabet (2008)
 - ◆ Compared actual distraction effects to drivers' estimated distraction effects
 - ◆ Overall, poor calibration to distraction effects
- Drivers may engage in potentially distracting activities because they are not aware of the effects
 - ◆ Calibration likely one of many factors
- Calibration
 - ◆ Different approaches, definitions and components



Calibration

- In studies of probabilistic judgment
 - ◆ Often two forced choice alternative questions, coupled with assessment of confidence



$$CALIBRATION = \frac{1}{n} \sum_{j=1}^J n_j (\Psi_j - e_j)^2$$

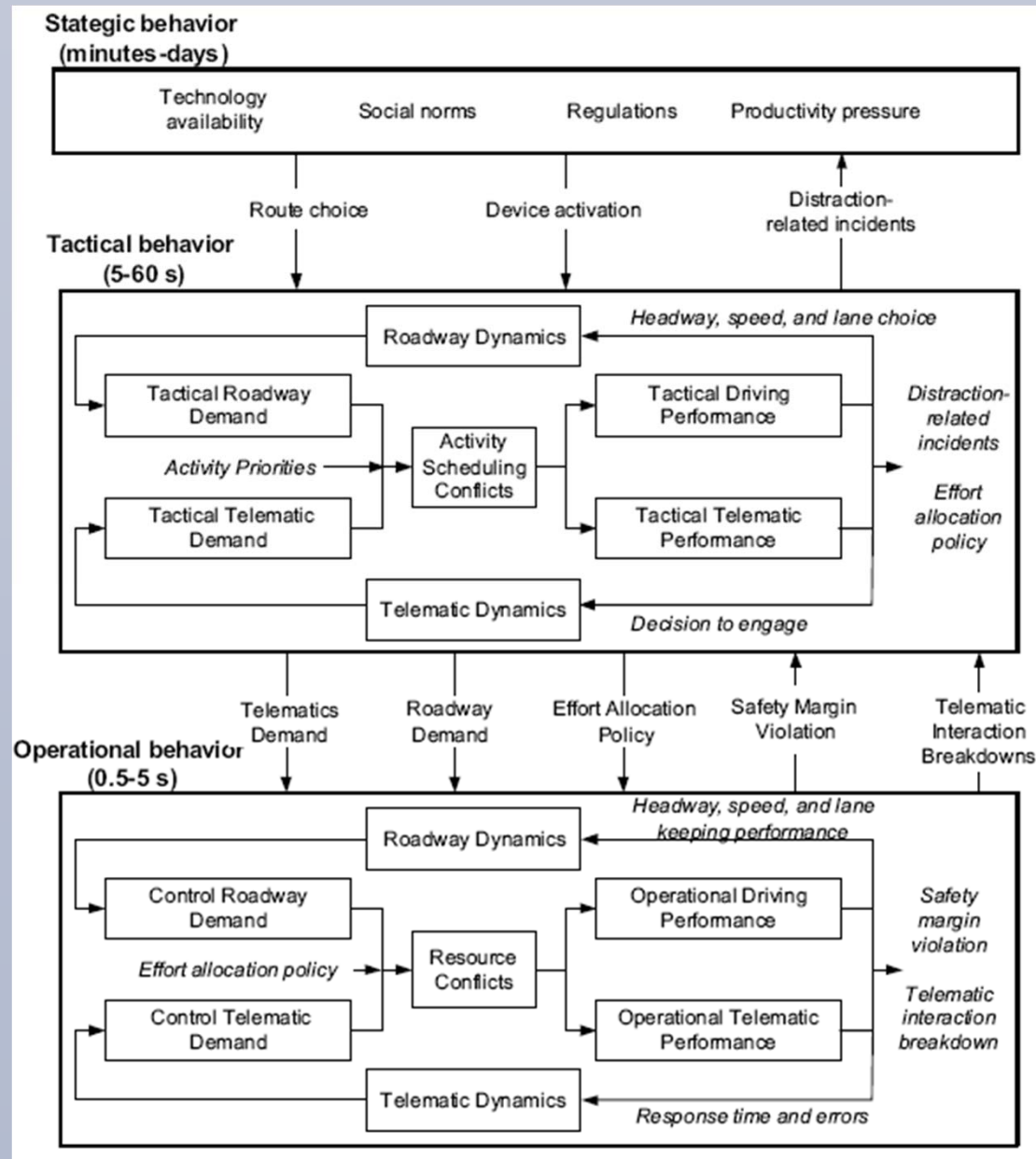
$$RESOLUTION = \left[\frac{1}{n} \sum_{j=1}^J n_j (e_j - e)^2 \right] / e(1-e)$$

$$OVER/UNDERCONFIDENCE = \Psi - e$$

- In driving context:
 - ◆ Number of trials
 - ◆ Metrics need to be conducive
 - ◆ Confidence versus accuracy in perception

Calibration

- Driving domain
 - ◆ Calibration, in some theories, is considered the matching of the driving demands to driver capabilities
 - ◆ When demands > capabilities, well-calibrated driver will act to bring two into alignment
 - ◆ Fuller (2005), Mitsopoulos-Rubens (2010), de Craen (2010)
 - ◆ Errors in calibration can manifest at different levels of driving task
 - ◆ Can result in a cascading effect across different levels (Lee, 2007)
 - ◆ Deal mostly with confidence in or perceived skills and abilities
 - ◆ Though local performance judgments are certainly involved



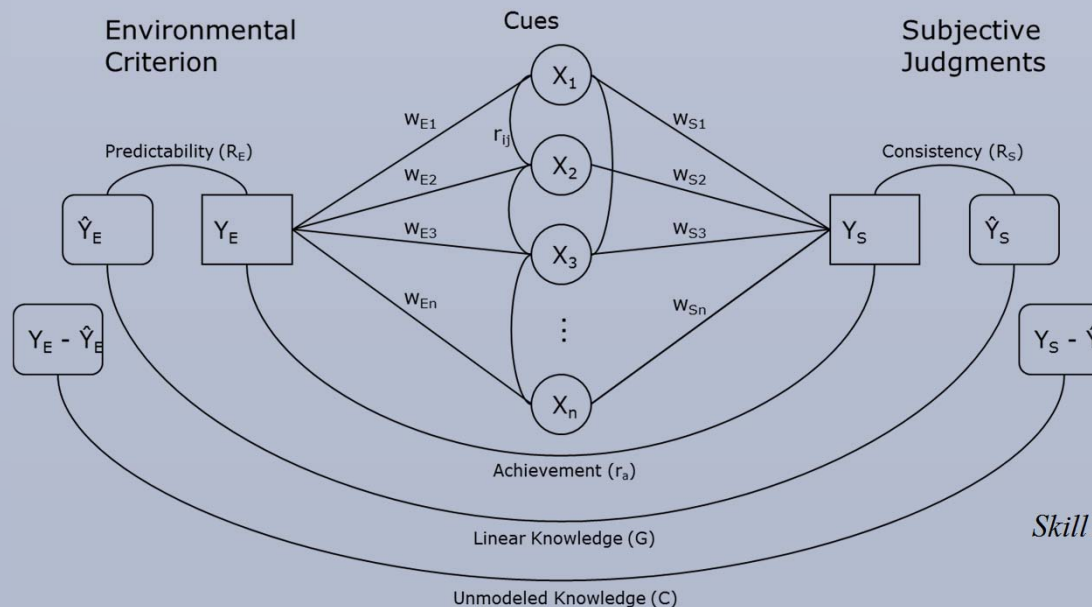
Lee & Strayer (2004)

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Lens Model

- Lens model
 - ◆ Originally used to characterize perception (Brunswik, 1952)
 - ◆ Later elaborated in the context of decision making and judgments (Hammond, 1955)
- Differentiates between judgment and true state of the world based on the weighing of information cues
- Derived measures of judgment quality and other metrics



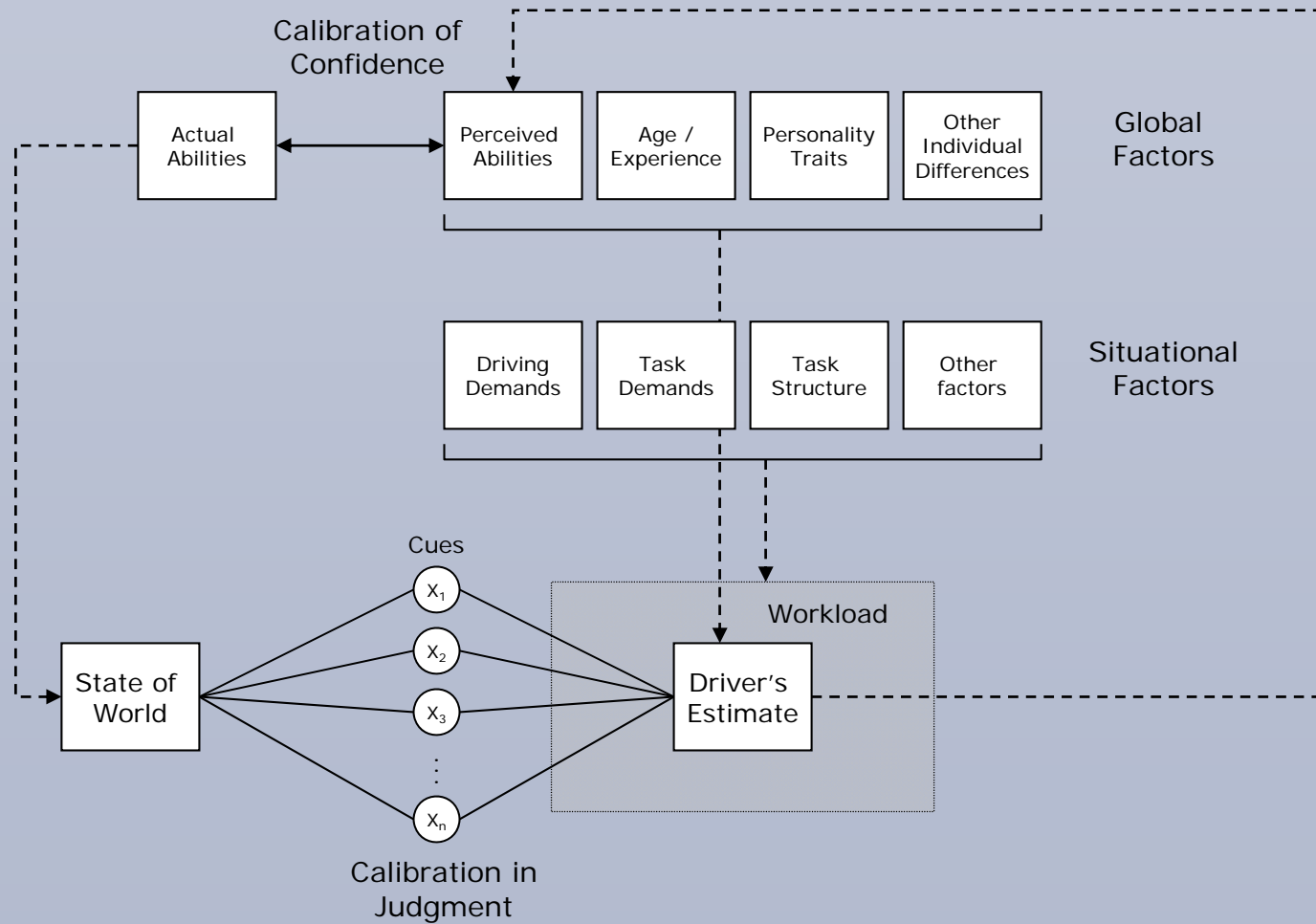
$$r_a = GR_E R_J + C \sqrt{1 - R_E^2} \sqrt{1 - R_J^2}$$

$$Skill\ Score\ (SS) = (r_{JE})^2 - \left[\frac{r_{JE}}{(s_J/s_E)} \right]^2 - \left[\frac{(\bar{J} - \bar{E})}{s_J} \right]^2$$

Framework for study of calibration

- Goal: to develop a framework that can guide program of research in calibration and driving
- Calibration of confidence and in perceptual judgments should be considered
- Consider the global and situational factors that can influence calibration
 - ◆ Role of distraction
- Work in progress
 - ◆ Currently looking at factors that can influence calibration
 - ◆ Needs to be expanded to look at downstream implications of good and poor calibration

Framework (work in progress)



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