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VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

Safer Glances, Driver Inattention, and Crash Risk: A SHRP2 Analysis

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SHRP2

- Largest and most comprehensive naturalistic driving study ever conducted
- 2,800 drivers recorded for 1 to 2 years
- 33,000,000 travel miles, 3,800 vehicle-years of driving, >4 petabytes of data
- Ours is one of three SHRP2 analysis projects
  - 1st phase ended late 2012
  - 2nd phase will end in July 2014.

SHRP2 SOLUTIONS

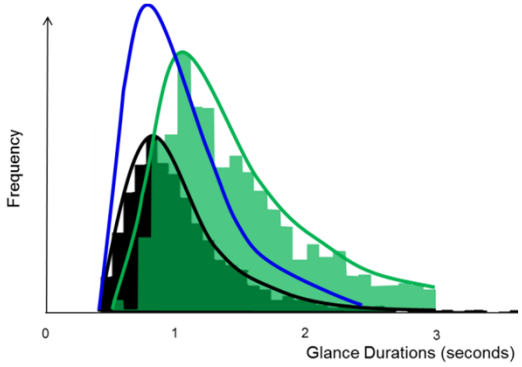
Naturalistic Driving Study Data Access Website

The SHRP 2 Data Access Website provides access to data collected in the SHRP 2 Naturalistic Driving Study. Data are available to describe collection progress, participating drivers and their vehicles, and available crash data. Data dictionaries and descriptions of data collection procedures are also available.

Research Topic

- Determine the relationship between driver inattention and crash risk in lead-vehicle pre-crash scenarios

- Show which glance behaviors are safer than others
- Pinpoint the most dangerous glances away from the road



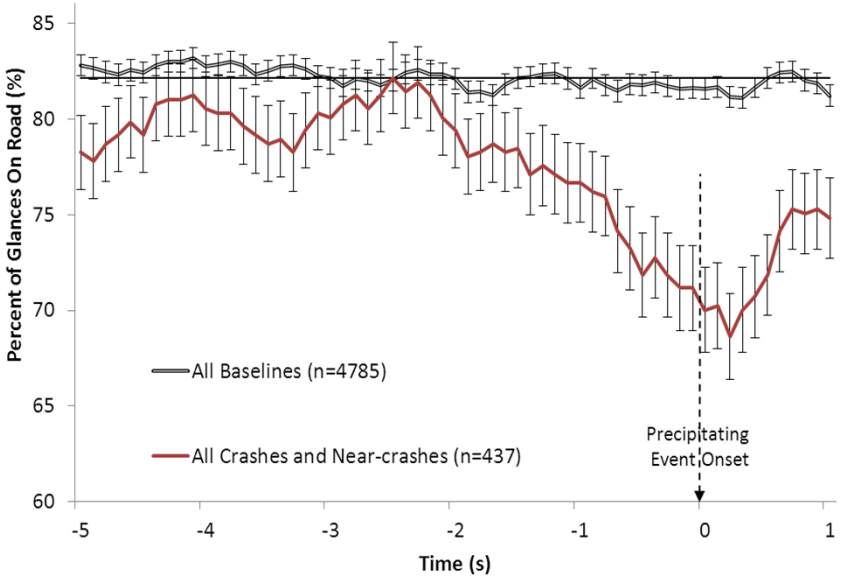
1. Support distraction policy, regulation, guidelines
2. Improve intelligent vehicle systems, e.g. FCW
3. Teach safe glance behaviors

State-of-the-art

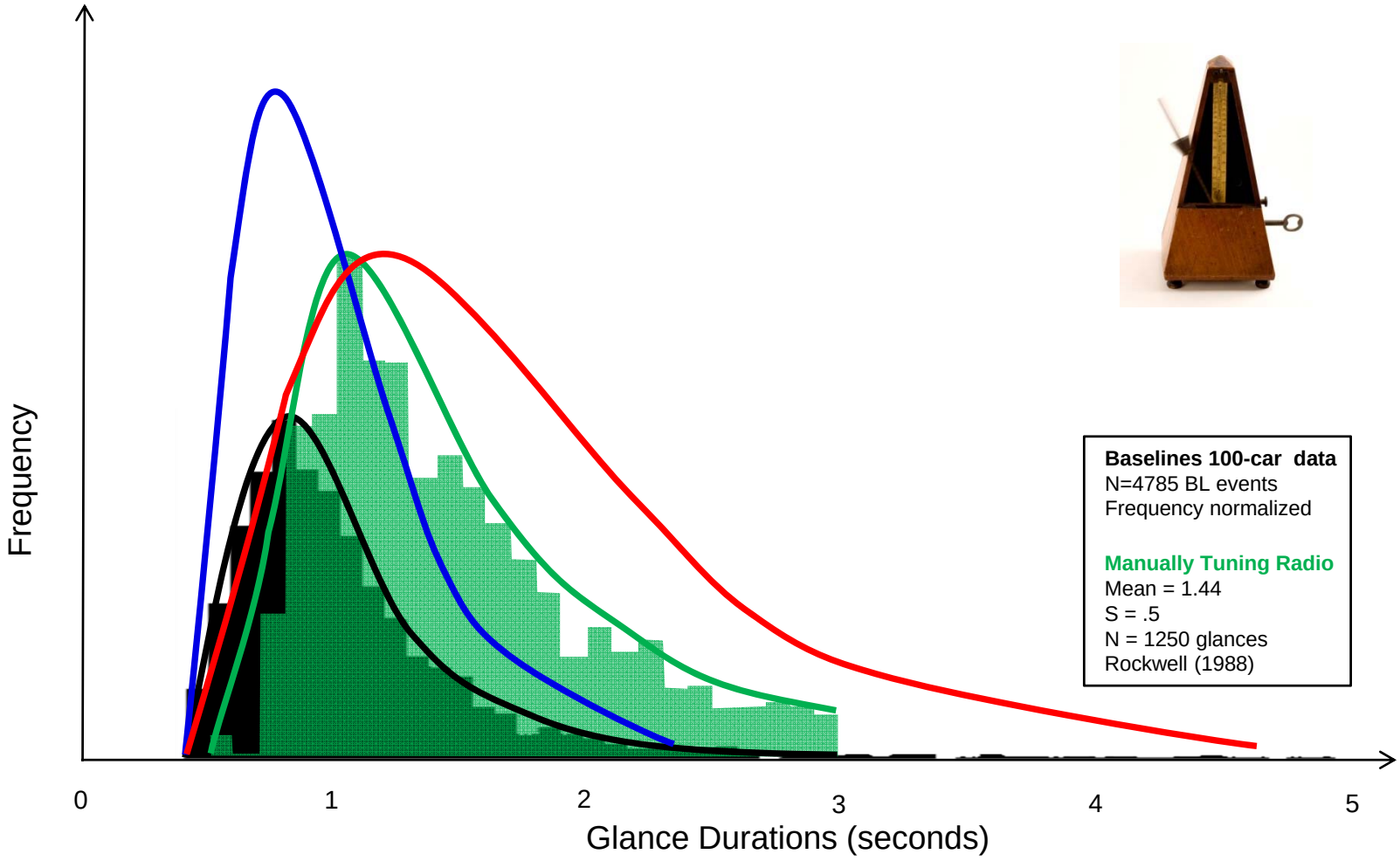
- High **total glance times** (e.g., 2 seconds or more in a 6 second period) are associated with increased crash/near-crash risk (Klauer et al. 2006; 2010).

- **Single off-road glance duration** was the best crash predictor (Liang, et al, 2012). Glance history (such as total glance time) and glance location did not improve risk estimation above single glance duration but they were predictive.

- Risk is primarily associated with an **inopportune single glance duration** (Victor and Dozza 2011; Victor, Dozza, and Lee, Forthcoming). The longer the driver looks away from the road at the Precipitating Event, the greater the risk.

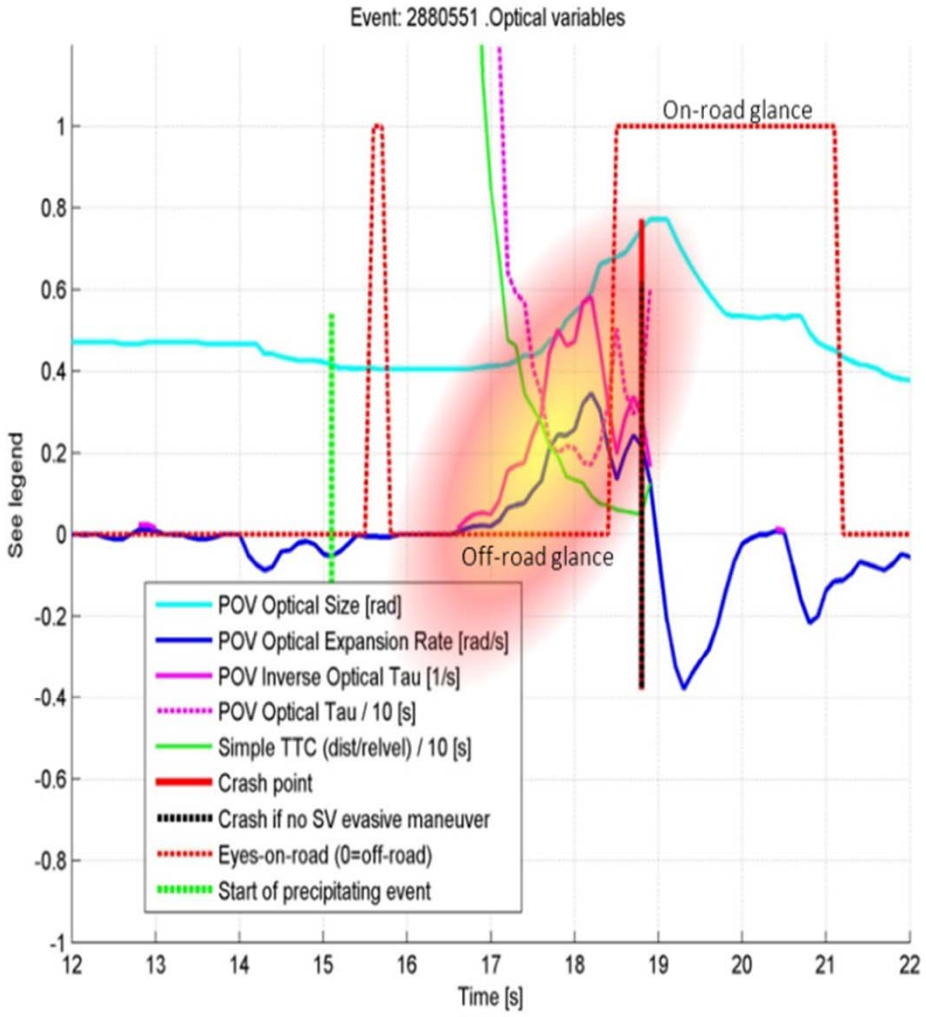


Risk-Quantified Glance Behavior

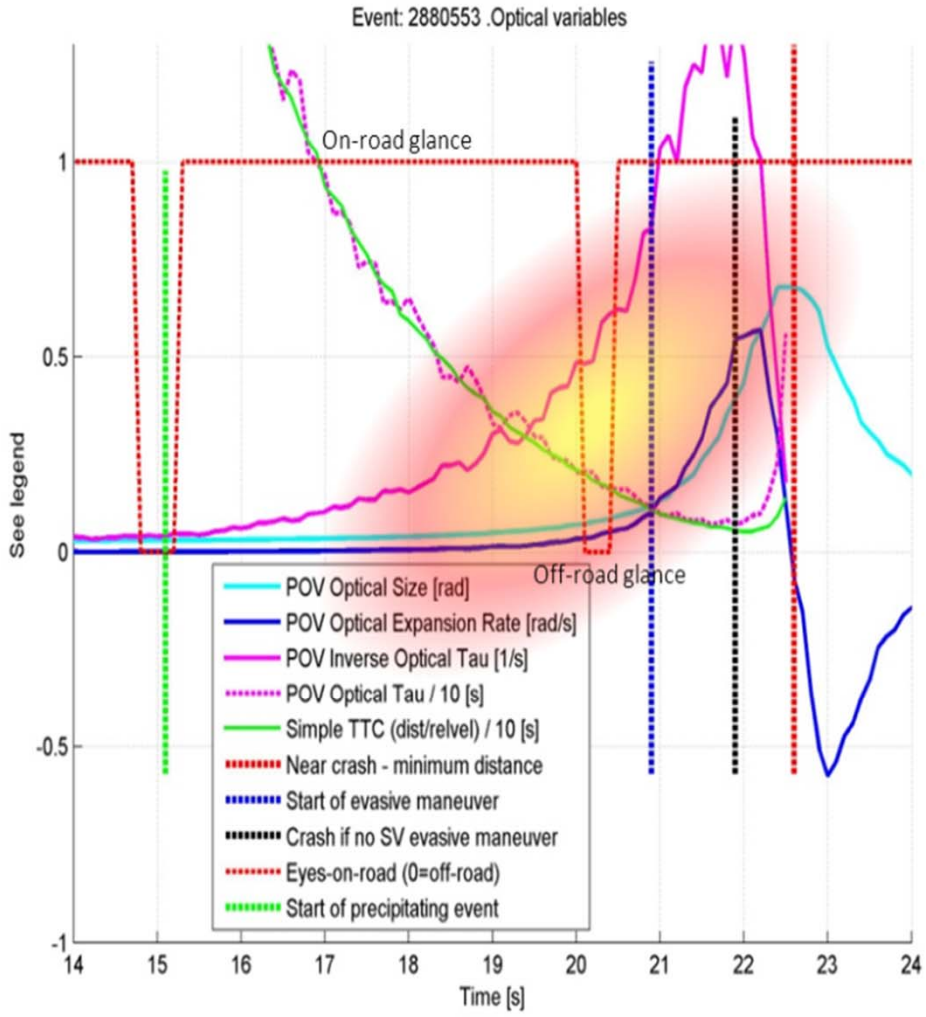


Example Results Phase 1

Crash



Near-Crash



Phase 2 Data

- Minimum 220 lead-vehicle crashes/near-crashes
  - At least 100 crashes & 100 near-crashes
- Minimum 220 Baselines
  - 50% Matching Baseline
  - 50% Random Baseline

Analysis Steps

Step 1. Replication – Replicate our previous results with SHRP2 data.

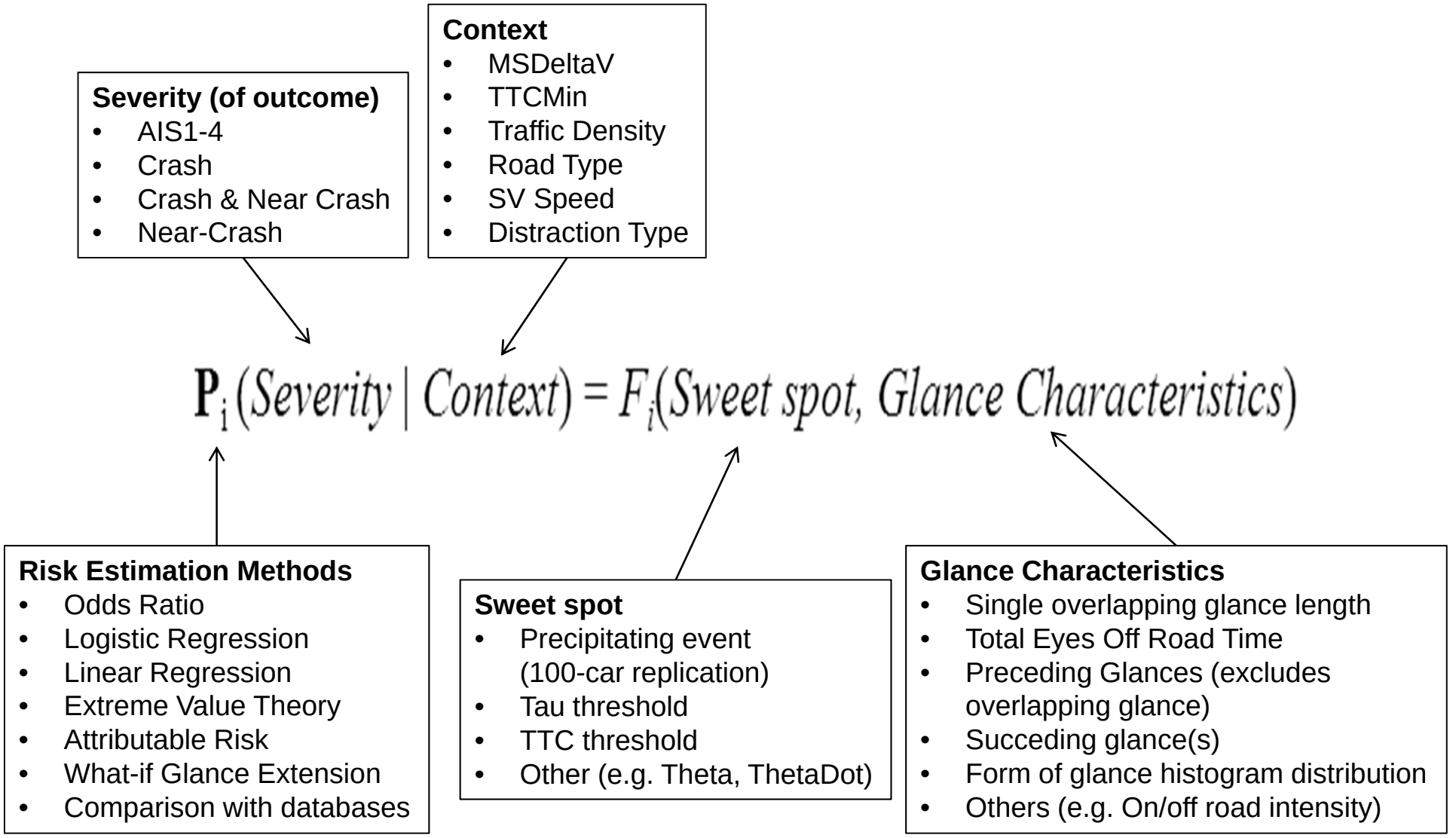
Step 2. Sweet spot – Identify the sweet spot for visual control of braking.

Step 3. Glance Characteristics – Quantify which glance measures best capture risk.

Step 4. Severity Scales – New severity scales

Step 5. A set of Inattention-Risk Functions

$$P_i(Severity \mid Context) = F_i(Sweet\ spot,\ Glance\ Characteristics)$$


Severity (of outcome)
• AIS1-4
• Crash
• Crash & Near Crash
• Near-Crash
Context
• MSDeltaV
• TTCMin
• Traffic Density
• Road Type
• SV Speed
• Distraction Type
$P_i(Severity \mid Context) = F_i(Sweet\ spot, Glance\ Characteristics)$
Risk Estimation Methods
• Odds Ratio
• Logistic Regression
• Linear Regression
• Extreme Value Theory
• Attributable Risk
• What-if Glance Extension
• Comparison with databases
Sweet spot
• Precipitating event (100-car replication)
• Tau threshold
• TTC threshold
• Other (e.g. Theta, ThetaDot)
Glance Characteristics
• Single overlapping glance length
• Total Eyes Off Road Time
• Preceding Glances (excludes overlapping glance)
• Succeding glance(s)
• Form of glance histogram distribution
• Others (e.g. On/off road intensity)

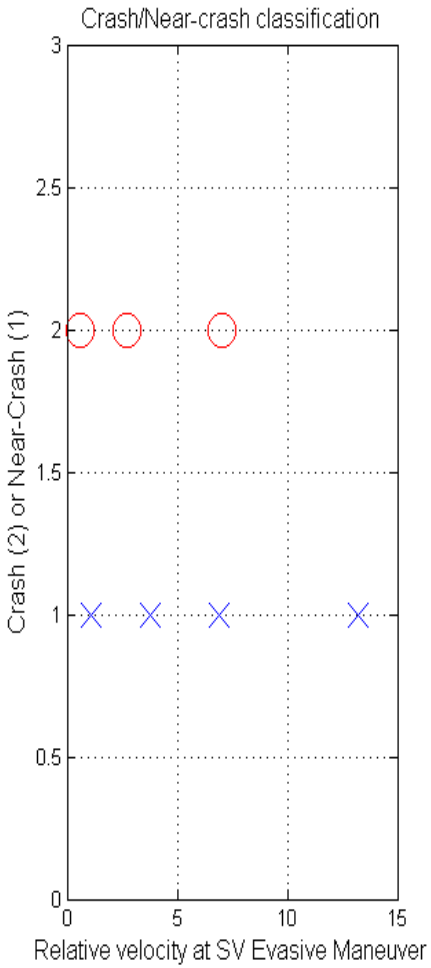
Countermeasures

- **Distraction Guidelines**
  - Address current limitations in scientific knowledge. More evidence for performance testing.
  - Support evidence-based distraction policy and regulations,
  - used to teach safe glance behaviors.

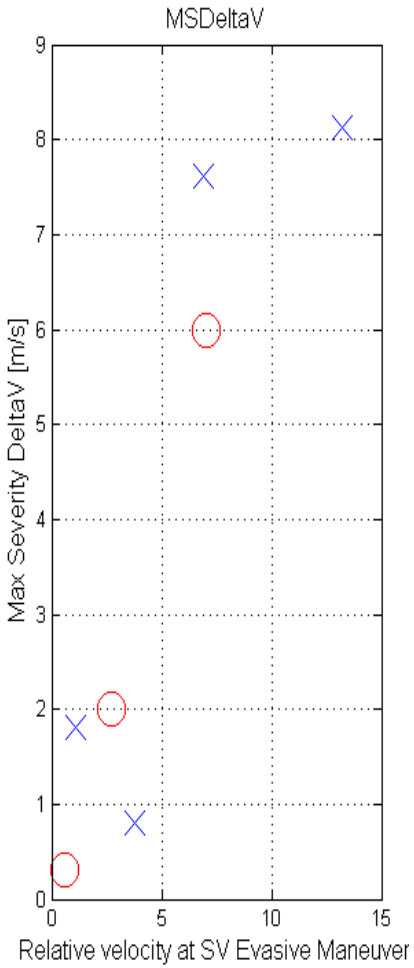
- **Safety Systems**
  - Improve **Forward Collision Warning** system to be inattention-adaptive. It will reduce nuisance warnings. Warn more exactly when the risk is greatest.
  - Greatly improve **distraction/inattention detection** because the inattention-risk functions directly describe what a system should be looking for.
  - **Distraction feedback** can more appropriately be given, and driver coaching feedback is improved.

End

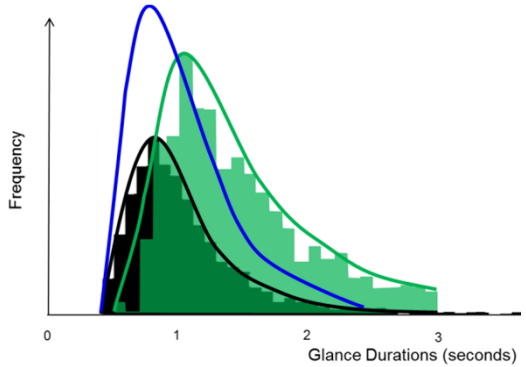
Traditional



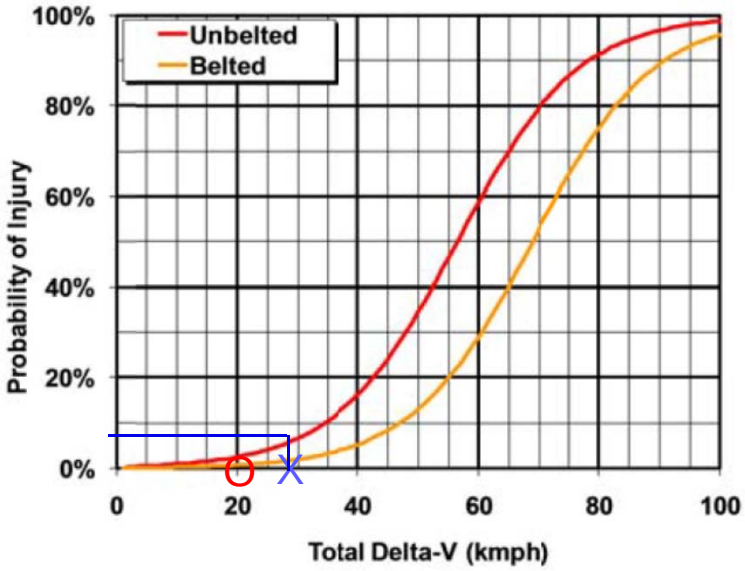
MSDeltaV: max severity



From Probability of Crash/Near-crash



To Probability of injury



(Kusano & Gabler, 2008)