International Conference on Commercial Driver Health & Wellness

Two Behavioral Red Flags: Driver Single-Vehicle Crash Involvement and Safety Belt Non-Use

Ronald R. Knipling, Ph.D.
Principal, *safetyforthelonghaul.com*

Abstract. Numerous studies have established the principle of *differential driver risk* for both commercial drivers and for drivers in general. Naturalistic driving and other studies indicate that approximately 20% of drivers are associated with about 50% of all at-fault road conflicts. These percentages translate into a roughly five-fold difference in risk between high-risk drivers and the rest of drivers. For high-drowsiness incident involvements, differential risk is even greater. Individual differences in risk appear to primarily reflect enduring individual differences (i.e., traits) rather than temporary states, even though multiple temporary factors are always operating to affect driver crash risk. Medical factors play a role in differential driver risk, though personality (defined broadly as behavioral and attitudinal consistency) probably plays a bigger role.

How can carriers discern which commercial drivers are high-risk during driver screening and hiring, and then later for drivers actually hired? Two indicators are suggested here. The first is driver involvement in a serious single-vehicle crash, either in the recent past (e.g., for applicants) or while in service with a company. Single-vehicle crashes are, for the most part, fundamentally different from multi-vehicle crashes in their causation. They typically indicate a failure of driver *vehicle control*, whereas multi-vehicle crashes reflect primarily a failure of *response to traffic events*. Compared to at-fault multi-vehicle crashes, Large Truck Crash Causation Study (LTCCS) single-vehicle crashes were 13 times more likely to have a proximal cause of asleep-at-the-wheel, three times more likely involve a heart attack or other medical event, and nearly three times more likely to be due to a performance/response execution failure. They are also more likely to involve pre-crash misbehaviors such as speeding and neglect of vehicle maintenance. Any type of at-fault crash involvement can raise questions about a driver, but involvement in a single-vehicle crash raises more fundamental questions about his or her fitness and suitability for the driving profession.

Non-use of safety belts is linked to single-vehicle crash involvements, and to driver risk in general. In the LTCCS, non-belt users were 84% more likely to be involved in single-vehicle crashes relative to multi-vehicle crashes. Overall, they were 30% more likely to be at-fault (i.e., assigned the Critical Reason) in their crashes. A large naturalistic driving study found that high-drowsiness road conflicts were 70% more likely for non-belt users than users, with the probable link being driver obesity, itself a major health and safety concern.

Studies of light vehicle drivers corroborate the link between non-belt use and driving risk. Non-belt use is linked to cell phone use, alcohol, speeding, reckless driving, license-related violations, and past criminal offenses. Individual *risk perception* appears to be a key common factor in both belt non-use and engagement in at-risk driving behaviors.

These facts also imply a greatly elevated *injury* risk for non-belt users because of the *multiplicative* relationship between increased crash risk and increased injury risk in crashes that occur. If non-belt users have a 1.5× probability of being in a crash (a conservative estimate for single-vehicle crashes where drivers are most likely to be injured), and a 3× increase in injury severity in crashes that occur, then they have an overall 4.5× injury risk per unit of driving. Such evidence and extrapolations suggest that government and industry should closely scrutinize behavioral “red flags” such as single-vehicle crash involvement and safety belt non-use.

Behavioral Red Flags: Driver Safety Belt Non-Use & Single-Vehicle Crash Involvement

Ronald R. Knipling, Ph.D.
www.safetyforthelonghaul.com

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Behavioral Red Flags: Driver Safety Belt Non-Use & Single-Vehicle Crash Involvement

- ***Preamble:*** **"Metaprinciples"**
- **Single-vehicle crashes as a risk indicator**
- **Safety-belt non-use as a risk indicator**

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Preamble: Psychological "Metaprinciples"

- Principle of **Individual Differences**
- Principle of **Behavior Consistency**
- Principle of Biological Determination
- Principle of Environmental Determination
- Principle of Self-Determination

Source: M. K. Holland, *Using Psychology; Principles of Behavior and Your Life*, 1975

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Psychological "Metaprinciples"

- **Individual Differences**
- **Behavior Consistency**

Different sides of the same coin!

- Biological Determination
- Environmental Determination
- Self-Determination

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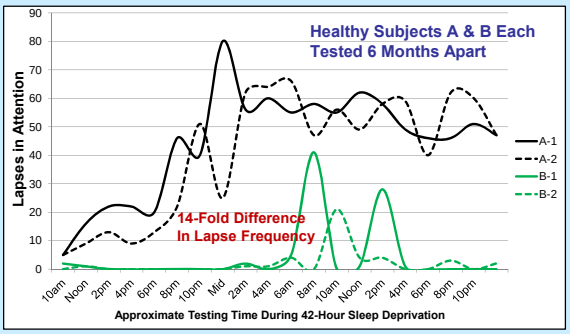
Sleep Deprivation Study: Differences Between Subjects, Consistency Within Subjects



Source: Dinges et al., 1998

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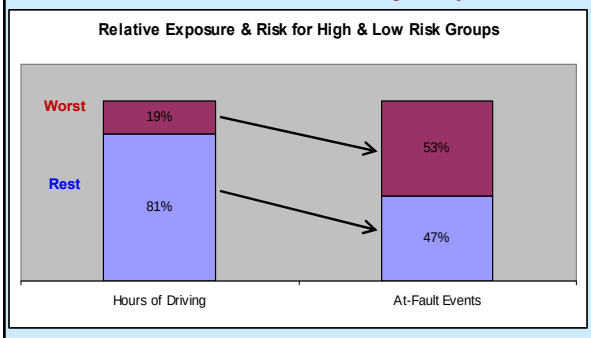
*Differential Driver Risk: **At-Fault** Traffic Conflicts Among 95 Drivers in VA Tech Naturalistic Driving Study*



Risk Odds Ratio = 4.9

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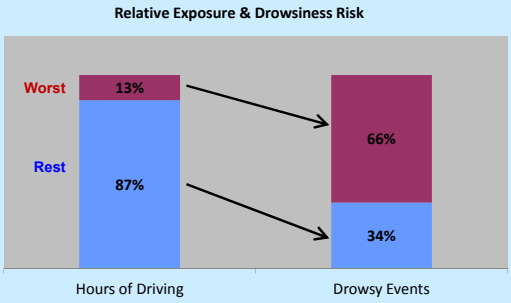
Extreme Differential Driver Fatigue Susceptibility

***High Drowsiness** Events: High- & Low-Risk Groups*



Risk Odds Ratio ≈ 13

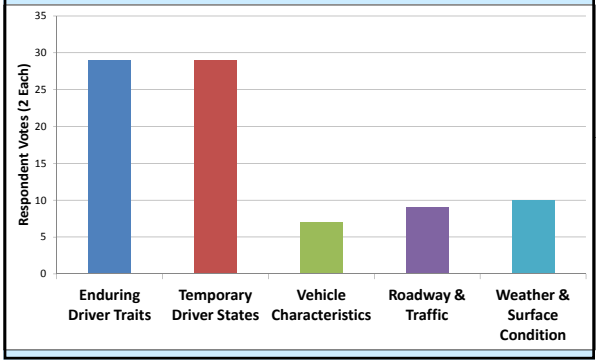
2004 Survey Results:

Consistency of Individual Differences

How much does relative driver risk change year-to-year?	Carrier Safety Managers	Other Experts
Risk **can change** dramatically	10%	0%
"Some tendency" to stay the same, but can change	25%	35%
Risk stays about the **same**	65%	65%

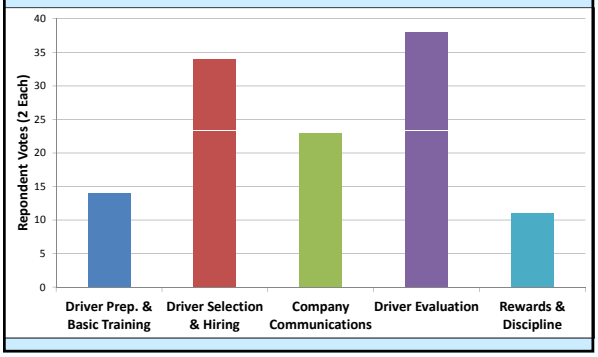
2010 Safety Manager Survey:

What most affects crash risk?



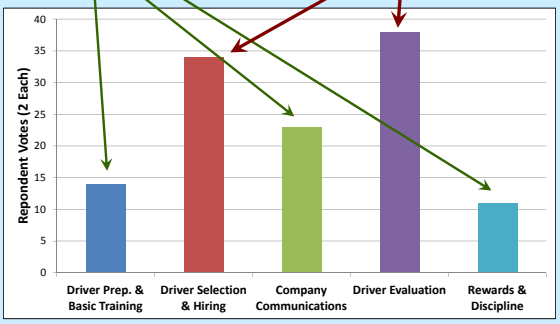
2010 Safety Manager Survey:

What are most important carrier practices?



Carrier Safety Manager Survey

Changing Behavior **Assessing Behavior**



End-of-Preamble Proverb:

"We cannot change the wind, but we can adjust the sails."

Three Large Truck Crash Categories
AKA
"THE GOOD, THE BAD, & THE UGLY"

- Large Truck Crash Causation Study (LTCCS) comparison of truck crash involvements:
  - Multi-vehicle other vehicle at-fault
  - Multi-vehicle truck at-fault
  - Single-vehicle (**SV**)

LTCCS Single-Vehicle vs. Multi-Vehicle Crashes

Critical Reasons (Proximal Causes)	Truck Single-Vehicle		Truck At-Fault Multi-Vehicle
Too fast for conditions or curve	30%	>	13%
Aggressive driving behavior	2%	>	0.5%
Asleep-at-the-wheel	13%	>	1%
Physical impairment (mostly heart attacks)	6%	>	2%
Response execution error	8%	>	3%
Vehicle failure (e.g., cargo shifts, brakes, tires)	13%	>	7%
Inattention (e.g., distraction, daydreaming)	13%	<	19%
Inadequate surveillance ("looked but did not see")	4%	<	19%

More Troubling!

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Crash in Driver Record:
SVs vs. All **MVs** [Fault Not Known]

- **SV** vs. all **MV** involvements:
  - **6X** speeding was CR
  - **10X** aggressive driving was CR
  - **32X** driver asleep-at-the-wheel
  - **8X** driver physical impairment (e.g., heart attack)
  - **7X** response execution error
  - **5X** vehicle factor was CR
  - **3.3X** truck driver not wearing safety belt

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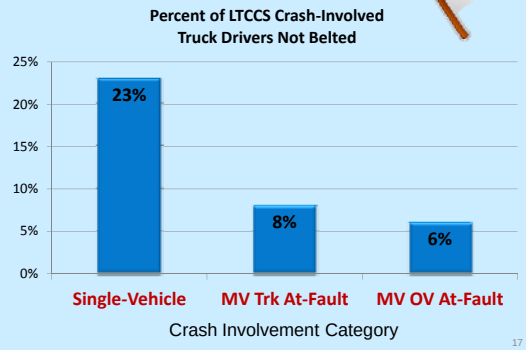
Recommendations Re: SV Crashes

- Fleet: Extra driver scrutiny for *any* **SV** crash
  - Selection: Assign extra weight as possible disqualifier.
  - Evaluation of current drivers: Carefully review crash circumstances & driver fitness.
- FMCSA & States:
  - **SV** crash *with injury* should trigger a ***driver review***. Also scrutinize carrier.
  - **~10,000** such crashes annually.

Non-Belt Use:
A Red Flag for Driver Risk



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Safety-Belt Use by BMI Classification
-- VTTI Truck Naturalistic Driving Study --

Seatbelt	Normal Weight (n=573)	Overweight (n=778)	Obese (n=1914)
Yes	80.8%	57.7%	56.2%
No	**19.2%**	**42.3%**	**43.8%**

Overweight/obese individuals were **3.2X** more likely *non-users*. They were also **9X** more likely to be rated as **drowsy** by video observers.

Source: Wiegand et al., 2008

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Self-Report Study of 2,030 U.S. Motorists

- 305 (15%) designated "aggressive" based on aggressive driving, high speeding, sign/signal violation, or impaired driving in past month.
- Aggressive drivers: 12% admitted non-belt use.
- Remaining drivers: 2% admitted non-belt use.
- Odds Ratio (aggressive driving given non-belt use) = **6.7**

Source: Beck et al., 2006.

Observation/Driver Records Study of Motorists: Biodata Ratios of Non-Belt Users to Users

Driver History	Day	Night
DWI/DUI Violation(s)	1.6	2.1
Moving Violation(s)	1.1	1.1
Speeding Violation(s)	1.0	1.2
Serious Moving Violation(s)	1.5	1.2
License Violation(s)	1.3	1.3
Criminal Offense(s)	1.0	1.5
Felony(ies)	1.0	1.2
Violent Crime(s)	0.9	1.3

Source: Bloomberg & Thomas, 2010

Personal Correlates w/ Safety Belt Non-Use

- Younger drivers
- Males
- Offenses (traffic & criminal)
- Alcohol use
- Obesity
- Aggressive driving
- Lower education
- Fatal crash involvement
- "Slack" risk perception (both crash & citation)
- Non-use often reinforced by peer subcultures

Non-Significant Naturalistic Driving Result

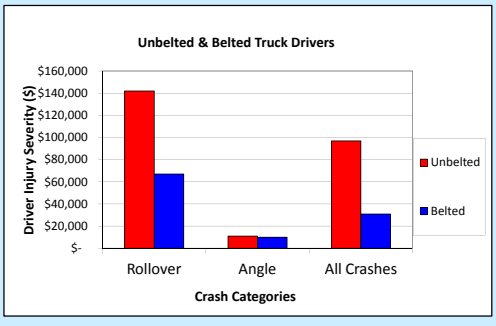
Belt Used?	913 Traffic Conflicts (Crashes, Near-Crashes, Incidents)	1,069 Baseline Events (Exposure Points)
Yes	55.2%	58.5%
No	44.8%	41.5%

Source: Hickman et al., 2005.
Note: Data collected 2003-2005. More recent data shows higher use but still no significant difference.

Injury Severity by Belt Use & Crash Type

Overall Injury Severity Ratio = 3.1

Injuries Greatest in SV Crashes



Source: Bahouth et al., 2007

Multiplicative Injury Harm Risk

Harm Risk = Probability of Crash × Injury Severity

Elevated Serious Crash Probability ≈ 1.5 [???]

Elevated Injury Severity ≈ 3.1 [Bahouth et al., 2007]

Elevated Injury Harm Risk ≈ 1.5 × 3.1 ≈ 4.6!!!

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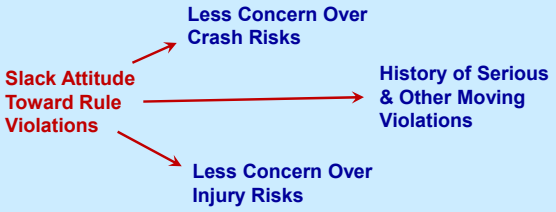
And it's illegal!!!

- **49 CFR 392.16**: "A commercial motor vehicle that has a seat belt assembly installed at the driver's seat shall not be driven unless the driver has properly restrained himself/herself with the seat belt assembly."



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Overall Conclusions

- **Huge individual differences in risk**
- **Yet individual behavior generally consistent across time and situations**
- **Compared to MV crashes, SV crashes are stronger indicators of behavioral and physical risk.**
- **Safety belt *non-use*:**
  - **Associated with SV crash involvements**
  - **Indicator of slack risk perception & likelihood of other violations & crashes**
  - **Indicator of greatly elevated injury risk.**

Thanks for your attention!
Ron Knipling
(703) 533-2895
rknipling@verizon.net
www.safetyforthelonghaul.com