Cognitive vs. Visual Distraction and Real-World Driving Safety: Why Different Research Methods May Yield Different Results

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Two Views of Cell Phones & Driving

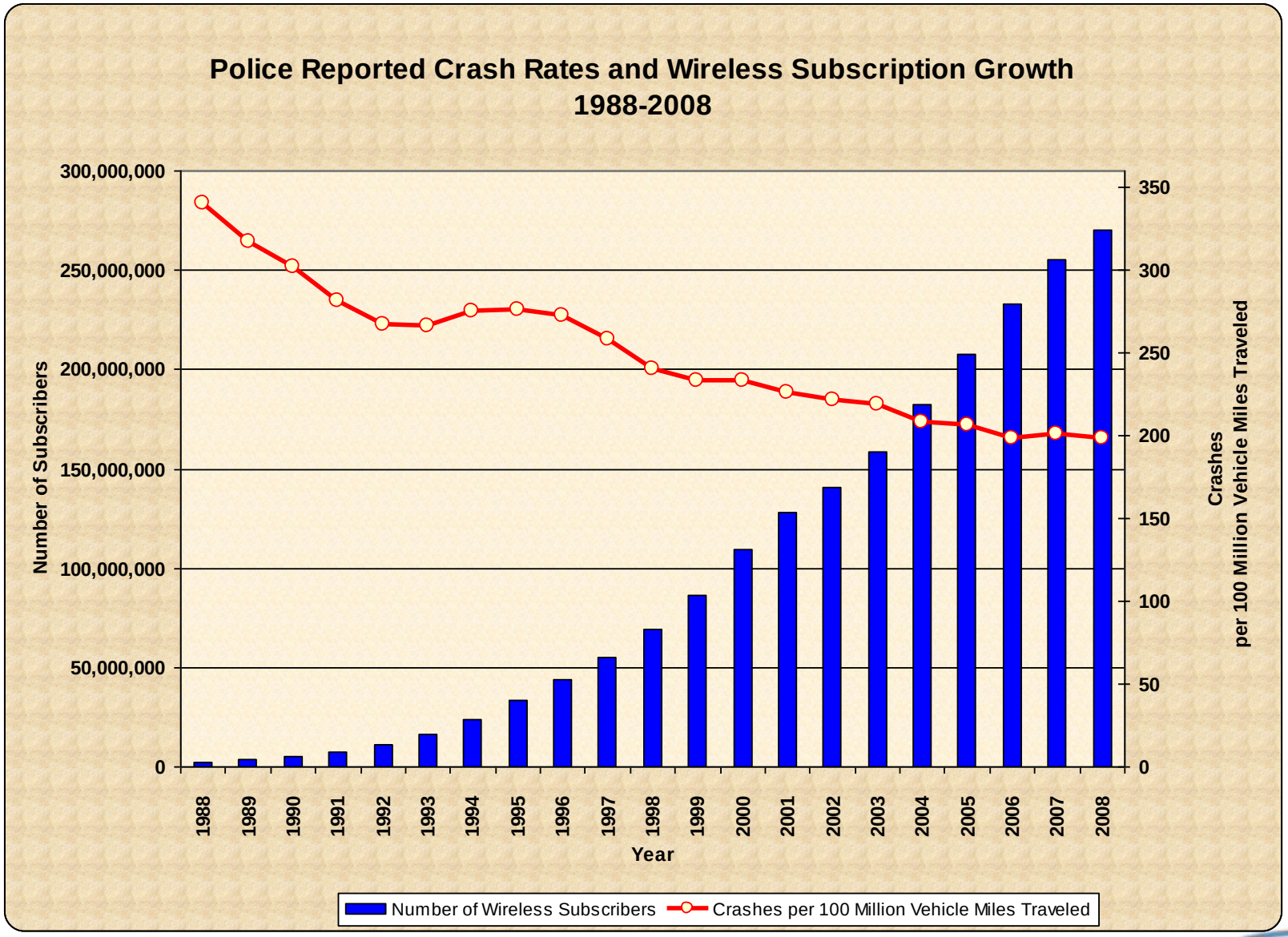
View X

- 'Using cell phones while driving is a very high risk behavior with significant impact on crashes'
- 'Drivers who use cell phones are 4.3 times more likely to be in a crash while using a cell phone'
- 'Impairments while talking on a cell phone can be as profound as driving with a blood alcohol level at 0.08%'
- 'There is no difference between hand-held and hands-free devices'
- 'Drivers can't control themselves and don't know what's going on around them on the road'
- 'Drivers should just shut up and drive!'

View Y

- 'There's been enormous growth in U.S. wireless subscriptions since 1995 while crash rates have continued to fall'
- 'The relative risk of accidents for cell phone vs. non-cell phone users is 1.38 (adjusted to 1.1-1.2 for exposure)'
- 'It (crash/near-crash risk) is nowhere close to the crash risk associated with driving at the legal limit for alcohol intoxication.'
- 'The risk for conversation handheld vs. handsfree is small (risk ratio of 1.0 to 1.3), it is unlikely to show up in the real world data'
- 'Drivers appear to use discretion, engage selectively in secondary behaviors when driving conditions are least demanding'
- 'When the driving demands are low, it is actually very difficult to devote all of our attention to the driving task'

Cell Phones Trends and Crash Rates



Sources: Traffic Safety Facts, DOT HS 811 002, NHTSA, 2007
Traffic Safety Annual Assessment, DOT HS 811 172, NHTSA, 2008
CTIA, ANNUALIZED WIRELESS INDUSTRY SURVEY RESULTS - DECEMBER 1985 TO DECEMBER 2008

Laberge-Nadeau, et al. (A.A.P., 2003)

Participants: N= 36,077

- Cell phone Users:
  - Males: 9352; Female: 3339
- Non-cell phone users:
  - Males: 13590; Female: 9797

Method:

- Two Cohorts Design (2 groups)
- Data sources: SAAQ questionnaire; driving records; cell phone call details

Analysis:

- Odds Ratio (OR) of having at least 1 crash in a given year calculated for cell phone users relative to non-users

Results:

- Risk is 1.38 higher for cell phone users
- Risk ratio drops to 1.11 (CI: 1.02, 1.22) for men and 1.21 (CI: 1.03, 1.40) for women when other factors (e.g., miles driven) are taken into account
- A dose-response relationship was found between frequency of cell phone use and crash risk
  - Heavy Use: Over twice baseline
  - Minimal use: Similar to baseline

- **All collisions (PDO & injuries)**
  - men: **adj. OR = 1,11**; 95% C.I. (1,02; 1,22)
  - women: **adj. OR = 1,21**; 95% C.I. (1,03; 1,40)
- **Collisions with injuries only**
  - men: **adj. OR = 1,10**; 95% C.I. (0,93; 1,30)
  - women: **adj. OR = 1,30**; 95% C.I. (1,00; 1,70)

RDCW FOT: Distraction Analysis
Sayer, Devonshire, & Flanagan (2005, 2007)

Participants:

- 36 of 78 Drivers, 4 weeks of driving, average 1062 miles/driver
- 40 video clips each
- 10 clips per week
- Randomly sampled

1440 video clips

- 5 sec in duration at 10 Hz
- Driver's face & forward scene

Performance data of interest

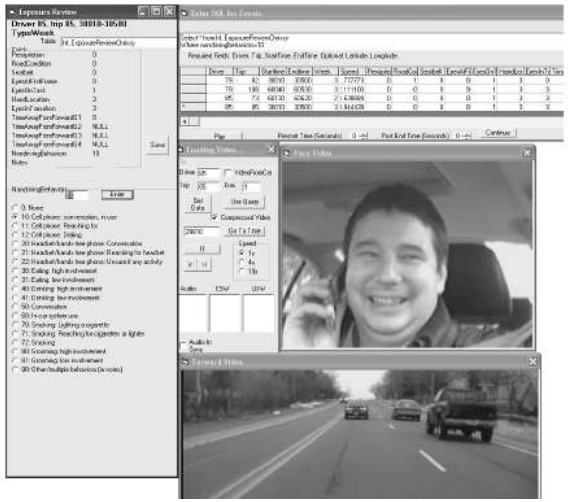
- Mean, variability of lane position
- Variability of steering wheel angle
- Speed variability
- Mean, variability of throttle position
- Glances away from road, durations

Contextual Factors

- Road type, curvature, road condition, weather

Secondary behaviors exposure review counts.

Observed Behavior	*f*	%	Multiple behaviors (*f*)
No secondary behavior	954	66.2	
Conversation	219	15.3	21
Grooming	96	6.5	26
Cellular phone	76	5.3	10
Eating/Drinking	28	1.9	2
Multiple behaviors	31	2.2	-
Other	36	2.5	5
Total	1,440	100	64



RDCW FOT Distraction Study Results: Driving Performance Effects

From Sayers, et al. (2005)

- Secondary behaviors are not equal in their frequency of occurrence, nor their effects
- Cellular phone use
  - Had highest steering variance
  - Little differences lane variance
  - No change in speed variance
    - Braking actually smoother
  - Frequency and duration of glances lower than baseline
    - Which could be both good and bad
    - Eating and conversations resulted in more and longer glances

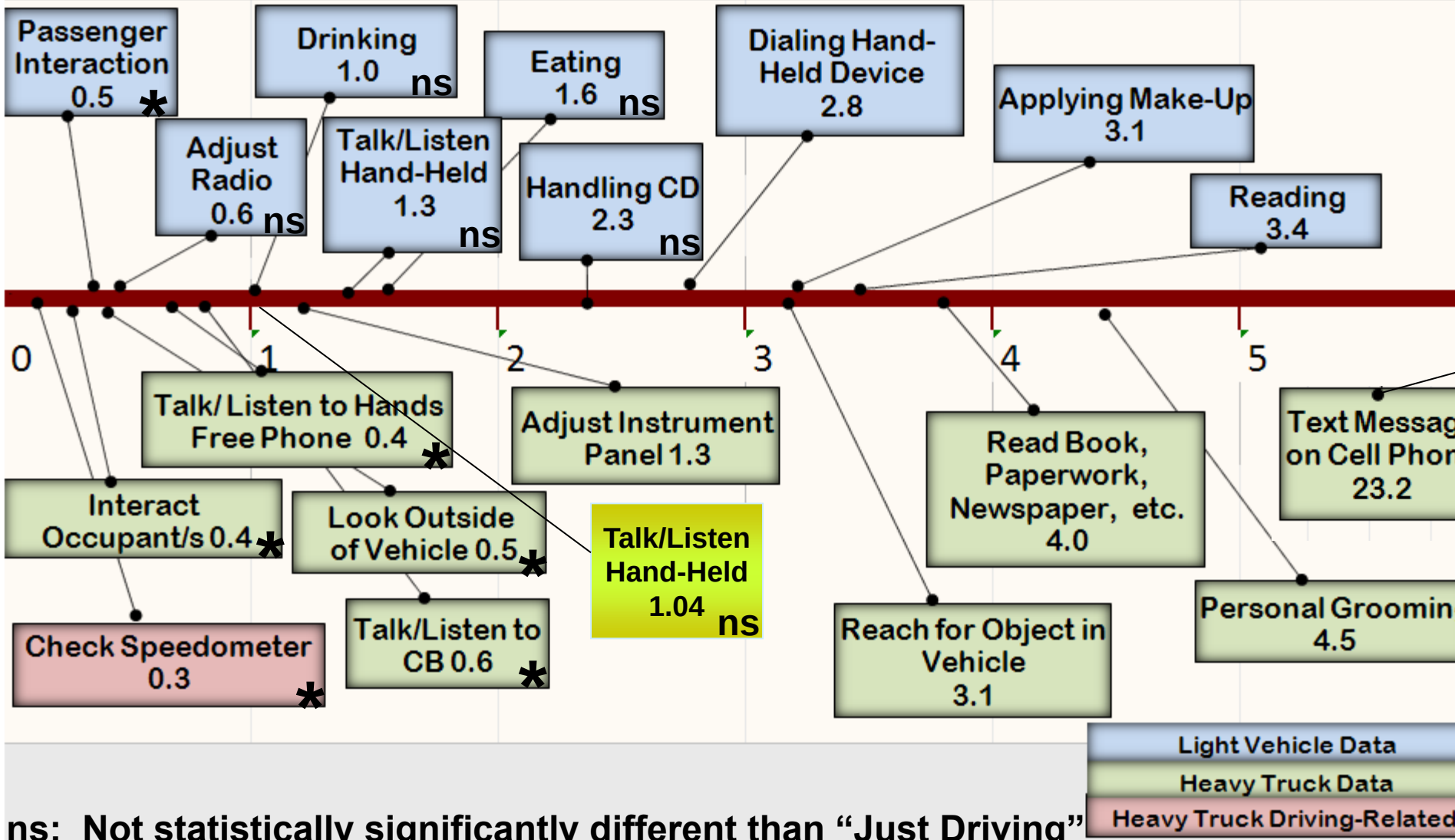
VTTI 100-Car and Other Large-Scale Naturalistic Driving Studies

- Sophisticated instrumentation w/video
- Drivers own cars/trucks; No specific instructions
- Over 600 drivers; 4 to 18 months each
- Over 100,000 hours of driving
- Over 7 million miles of data collection

Sponsors: FMCSA; NHTSA; NIH; and the National Center for Surface Transportation Safety Excellence; a consortium of FHWA, VDOT, GM, and Virginia Tech

Looking Away From the Road Raises Crash/Near Crash Risk

Non-Driving-Task Related Relative Crash/Near Crash Risk Estimates (Odds Ratio) (from Dingus, 2009



ns: Not statistically significantly different than “Just Driving”

* : Protective; statistically significantly <u>safer</u> than “Just Driving”

Why Don't Laboratory and Simulator Research Agree with Real-World Findings?

Laboratories and simulators are not the real world.

- By definition, they "simulate" the real world, but are not equal to it.
- Both can be used to assess driver performance, *but not to assess real-world risks that are influenced by driver behavior as well.*

These studies can suffer from

- unrealistic lab conversations
- biased test methods,
- lack of driver choice, and
- absence of driver risk compensation found on the road.

Research Cell Phone 'Conversations'

Underspecified

- e.g., 'Topics of interest to the participant'

Mental Arithmetic

- e.g.: 'How many miles will you travel in 2.5 hrs if you average 40 mph?' Driver: '100 mi'

Baddeley Grammatical Reasoning Test

- e.g.: 'B is not followed by A – BA.' Driver (correct response): 'False'

Working Memory Span Task

- Incoming message: 'The train bought a newspaper.' Driver (correct response): 'No' (not sensible)
- Incoming message: 'The boy brushed his teeth.' Driver (correct response): 'Yes' (sensible)
- After 5 sentences, recall the last word in each, in order

Cognitive Performance Assessment Batteries

- Monologue: Incoming message: 'Tell me as much as you can about the interior of your house'
- Mental puzzles: Incoming message: 'John is darker than Jim. Who is the lighter of the two?'

Current Controversies or emotionally-laden topics

- Scandals (e.g., Clinton Impeachment, Salt Lake City Olympics)
- 'Close Call' stories, describing a time when you almost died

Research Need: Content analysis of real-world cell-phone conversations while driving: When, where, how often, how long, listening vs. talking, etc.

Example: Decrease in Brain Activation Associated with Listening to Someone Speak (Just et al., 2008)

Result of fMRI Study: Simple auditory comprehension task led to 'deteriorated driving', 37% decrease in parietal lobe activation

But was this a 'realistic' driving evaluation?:

- Video game of a difficult 'winding' course
- Speed fixed at 43 mph
- 'Steering' was with a mouse or trackball, not a steering wheel
- Participants were told listening task and driving equally important
- No realistic feedback on lanekeeping error:
  - ' *If the participant happened to steer the car into the side edge (berm) of the road, the program prevented the vehicle from leaving the road but recorded each time it made contact with the boundaries of the road as a road-maintenance error.'* (p. 78)
- Participants responded by button press (not verbally)

Interpretive Issues:

- **How dangerous is it to think about whether "A phobia is an extreme attraction to an object…" is a true or false statement?**

Lab or Simulator Problem & Solution

Because laboratories/simulators need to operate under severe constraints (e.g., short time with the subject to get desired results), and are only approximations to the real world (sometimes poor at that), they should be used only for that which they are best suited: to evaluate driver **performance** for certain tasks.

Driver **behavior** is far more complex, and can only be evaluated in the real world, under real-world conditions, studied over time where the behavior is allowed to occur naturally, not artificially forced.

Final Thoughts

- Laboratory and simulator research can be suitable for assessment of driver performance but not for real-world risks that are shaped by driver behavior as well.
- What if the lab/simulator data (View X) and the real world data (View Y) don't match?
  - **The Real World should always take priority**!

End of Slides