

# The Risk of a Safety-Critical Event Associated with Mobile Device Use as a Function of Driving Task Demands

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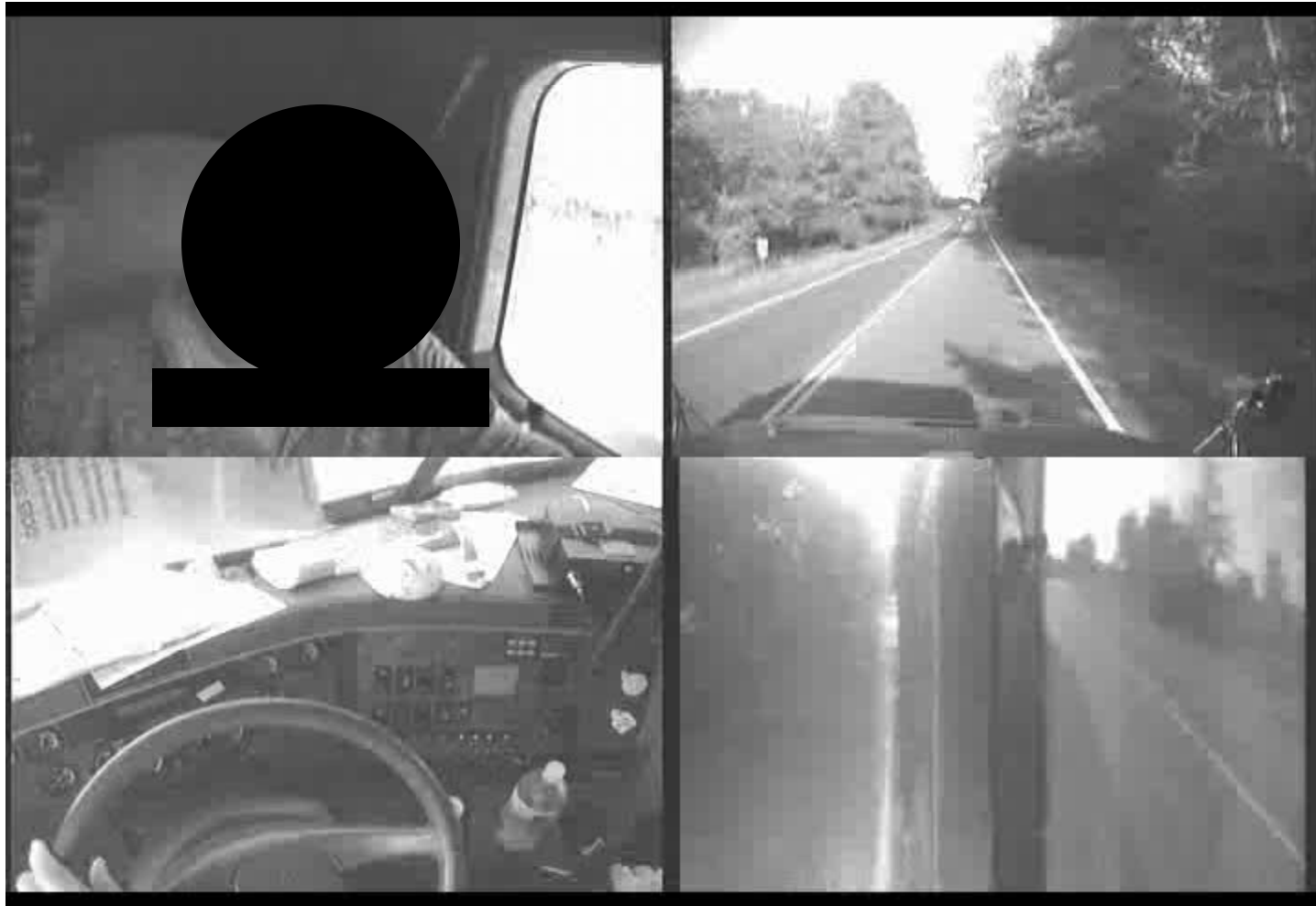


# Naturalistic Driving Research

- *In Situ* investigation of driver performance
  - Use an instrumented vehicle
  - No experimenter or instructions
  - Data continuously collected for extended period
  - High external validity
  - Hybrid of epidemiological & empirical
  - Over 600 drivers and 7 million miles
  - Used to investigate distraction



# Naturalistic Driving Research



# Risk Associated with Cell Phones

- Cell phone use – hand-held or hands-free - associated with a 4x increase in crash risk
- Increased risk associated with cell phone subtasks
  - Texting and dialing associated with an increased risk
  - Talking/listening not associated with an increased risk
- Found for both light and commercial vehicle drivers

# Why was Talking/Listening not Risky?

- Cases where driving task demands are high not isolated

# Objective

- Investigate SCE risk associated with mobile device use as a function of driving task demands

# Hypotheses

- $H_1$ : SCE risk associated with conversing in low driving task demands is expected to decrease
- $H_2$ : SCE risk in moderate driving task demands is expected to be independent of conversation
- $H_3$ : SCE risk associated with conversing in high driving task demands is expected to increase
- $H_4$ : SCE risk associated with complex tasks expected to increase in low, moderate and high driving task demands

# Method

- Re-analyze naturalistic datasets used to investigate CMV and LV distraction
- Identify low, moderate, and high driving task demands
- Compute odds ratios for mobile device subtasks in each subset



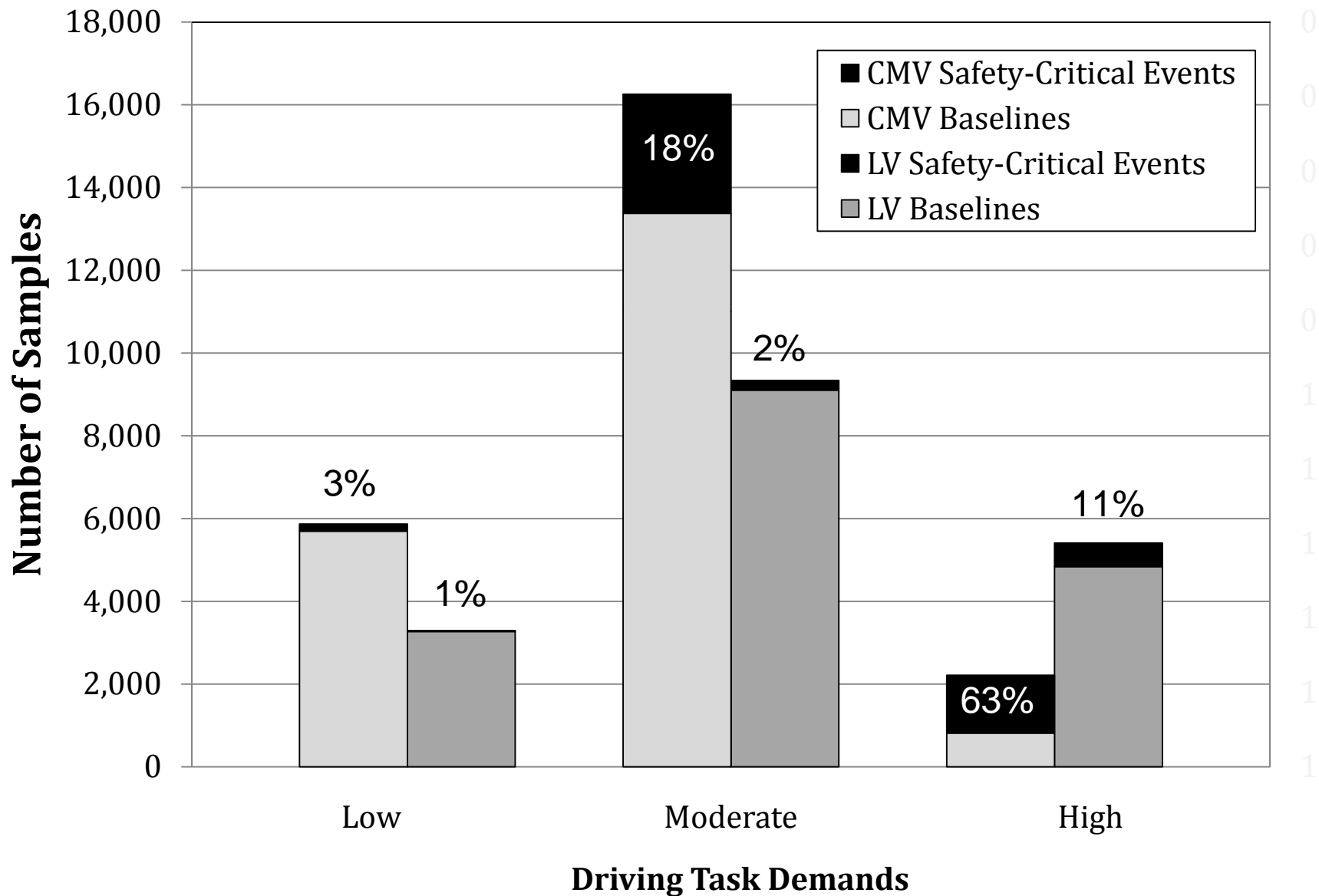
# Formulating Driving Task Demand Subsets

- Reviewed driver workload literature
- Identified exogenous factors
- Identified attributes in datasets that were reflective of exogenous factors

# Formulating Driving Task Demand Subsets

Driving Task Demands	Selection Criteria
Low	<ul style="list-style-type: none"><li>• All SCEs and baseline epochs that occurred on straight, level, and dry roads during daylight conditions with no adverse weather, at LOS A and that were not junction-related</li></ul>
Moderate	<ul style="list-style-type: none"><li>• All SCEs and baseline epochs that did not meet the “high” or “low” driving task demand selection criteria</li></ul>
High	<ul style="list-style-type: none"><li>• All SCEs and baseline epochs that were LOS C or greater, or</li><li>• All SCEs and baseline epochs that occurred at an intersection, were intersection related, occurred on an entrance/exit ramp, a driveway, or parking lot</li></ul>

# Driving Task Demand Subsets



# Risk in Low Driving Task Demands

Dataset	Task	Odds Ratio	95% C. I.	Frequency of SCEs	Frequency of Baselines	% of Subset
CMV Drivers	Cell phone use (Collapsed)	0.86	0.49 - 1.53	13	488	8.5%
	Text message on cell phone	-	-	0	1	0.0%
	Dial cell phone	1.83	0.44 - 7.65	2	36	0.6%
	Talking/listing on hand-held cell phone	1.37	0.69 - 2.72	9	218	3.9%
	Talking/listing on hands-free phone	0.26	0.06 - 1.05	2	244	4.2%
	Talking/listing on CB radio	1.50	0.47 - 4.81	3	66	1.2%
LV Drivers	Cell phone use (Collapsed)	2.39	0.81 - 7.03	4	241	7.4%
	Dial cell phone	12.98*	3.71 - 45.41	3	34	1.1%
	Talking/listing on hand-held phone	0.74	0.10 - 5.51	1	174	5.3%
	Interact with PDA	-	-	0	1	0.0%

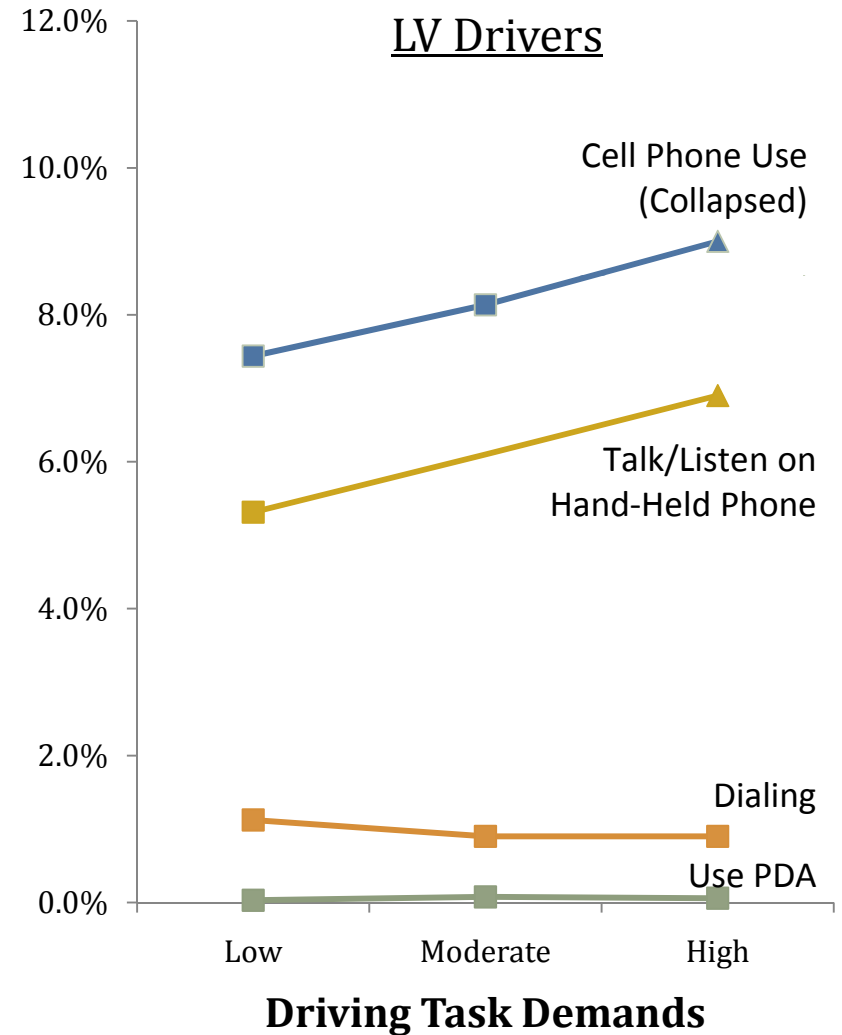
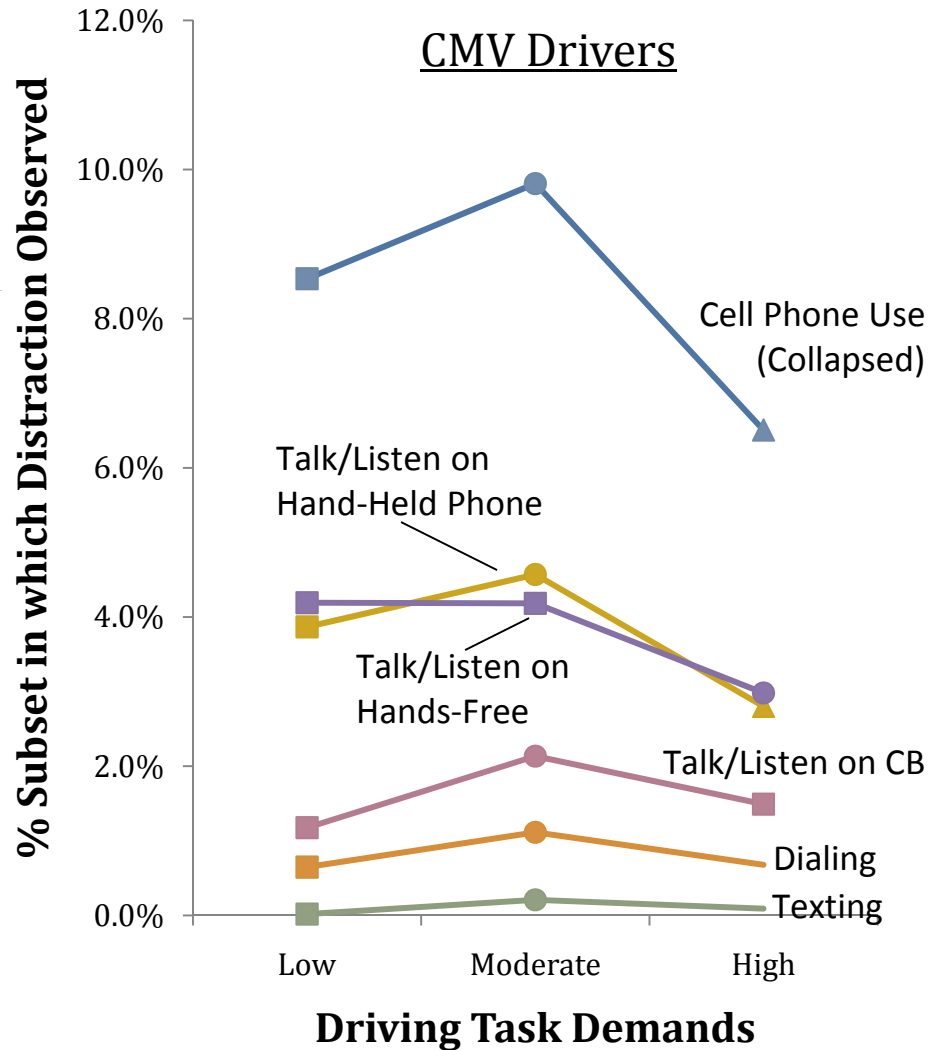
# Risk in Moderate Driving Task Demands

Dataset	Task	Odds Ratio	95% C. I.	Frequency of SCEs	Frequency of Baselines	% of Subset
CMV Drivers	Cell phone use (Collapsed)	1.25*	1.10 - 1.43	333	1262	9.8%
	Text message on cell phone	35.19*	12.39 – 99.96	30	4	0.2%
	Dial cell phone	9.98*	7.23 - 13.66	122	59	1.1%
	Talking/listing on hand-held cell phone	1.17	0.98 - 1.41	149	594	4.6%
	Talking/listing on hands-free phone	0.42*	0.32 - 0.55	58	622	4.2%
	Talking/listing on CB radio	0.37*	0.25 - 0.55	26	321	2.1%
LV Drivers	Cell phone use (Collapsed)	1.37	0.88 - 2.06	25	736	8.1%
	Dial cell phone	2.85*	1.23 - 6.59	6	83	1.0%
	Talking/listing on hand-held phone	1.35	0.84 - 2.18	19	555	6.1%
	Interact with PDA	7.78	0.90 - 66.83	1	5	0.1%

# Risk in High Driving Task Demands

Dataset	Task	Odds Ratio	95% C. I.	Frequency of SCEs	Frequency of Baselines	% of Subset
CMV Drivers	Cell phone use (Collapsed)	0.65*	0.46 - 0.92	77	67	6.5%
	Text message on cell phone	-	-	1	1	0.1%
	Dial cell phone	0.67	0.24 - 1.84	8	7	0.7%
	Talking/listing on hand-held cell phone	0.86	0.51 - 1.44	37	25	2.8%
	Talking/listing on hands-free phone	0.51*	0.31 - 0.82	31	35	3.0%
	Talking/listing on CB radio	1.02	0.50 - 2.09	21	12	1.5%
LV Drivers	Cell phone use (Collapsed)	0.55*	0.38 - 0.81	31	456	9.0%
	Dial cell phone	1.16	0.49 - 2.74	6	44	0.9%
	Talking/listing on hand-held phone	0.59*	0.39 - 0.89	25	351	7.0%
	Interact with PDA	-	-	0	4	0.1%

# Mobile Device Use across Driving Task Demands



# Discussion

- Complex subtasks associated with increased SCE risk in various driving task demands
  - Highlights importance of keeping eyes on the road
- Talking/listening not found to increase risk
  - Currently investigating compensatory behavior
- CMV drivers may regulate cell phone conversation



# Limitations

- Few complex subtask samples existed once data was divided into driving task demand subsets
- No control for drivers' time behind the wheel
  - Vigilance dependent on the length of the driver's shift
- Whether drivers changed their workload strategies was not investigated
- LV dataset skewed towards younger drivers and non-extended-highway driving

# Questions

