Technology Trends and Traffic Safety

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More change in next 5 years than previous 50

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Exponential increase: Unimaginable change

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Grundin, Iacanno, King (2005)

Moore's Law

2050

1970

Combinatorics

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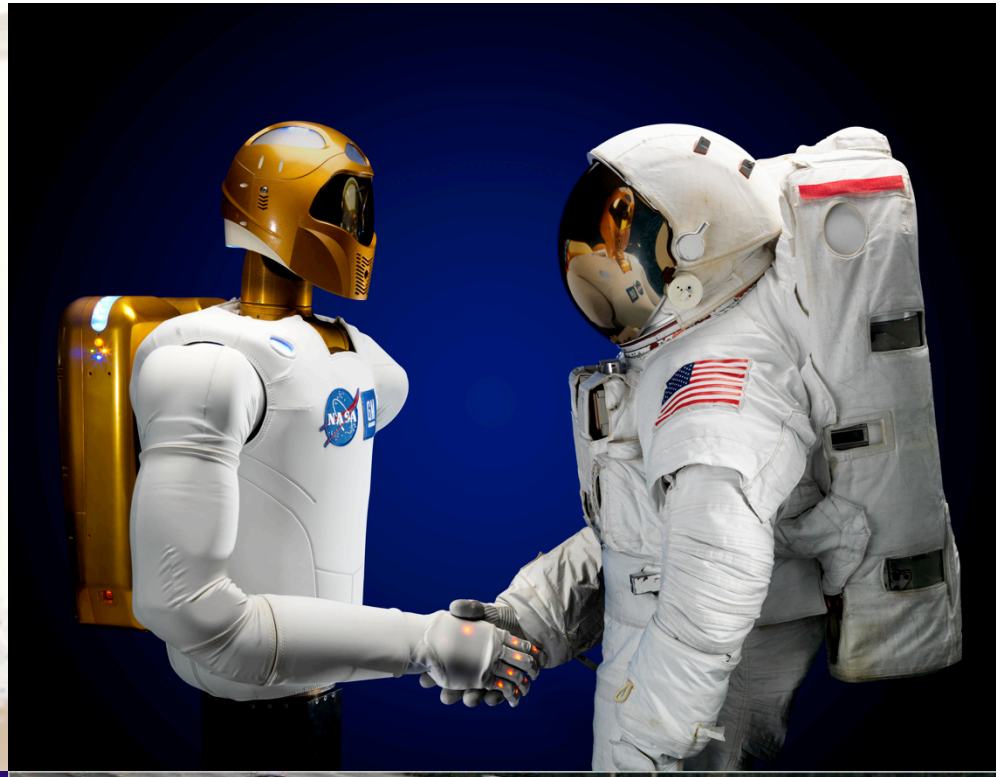
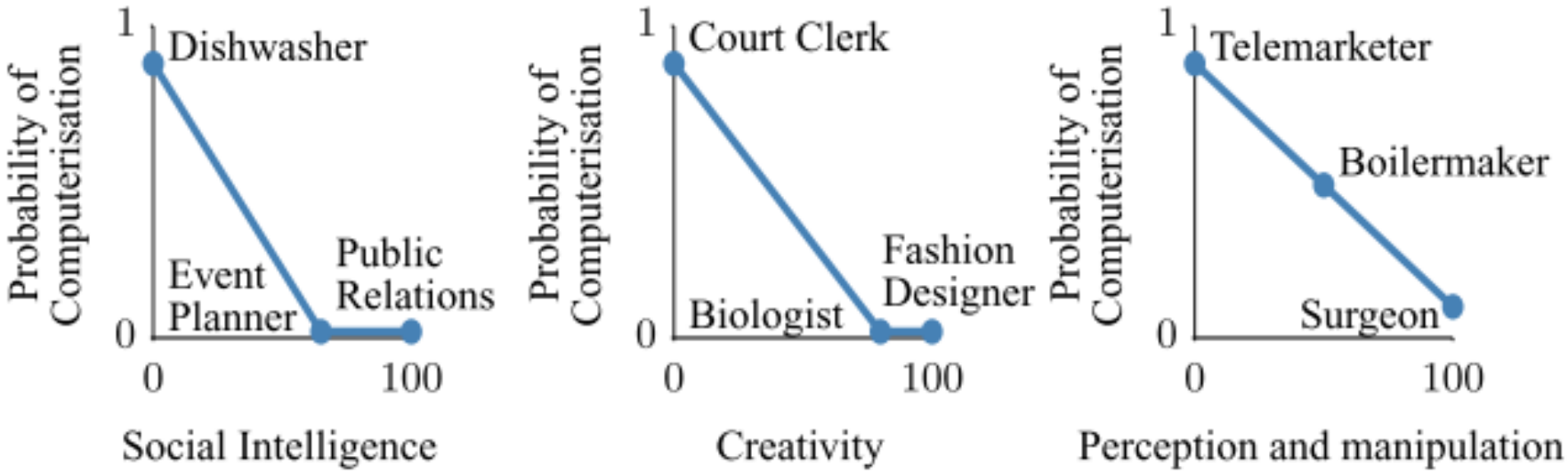
Kurtzweil (2010)


NASA


PIENSE
THINK
$4,200
Ken
$8,756
WATSON
$3,000
BRAD

Computerization puts 47% of jobs at risk



Frey, C. B., & Osborne, M. A. (2013). The future of employment: How susceptible are jobs to computerisation?, 1–72.

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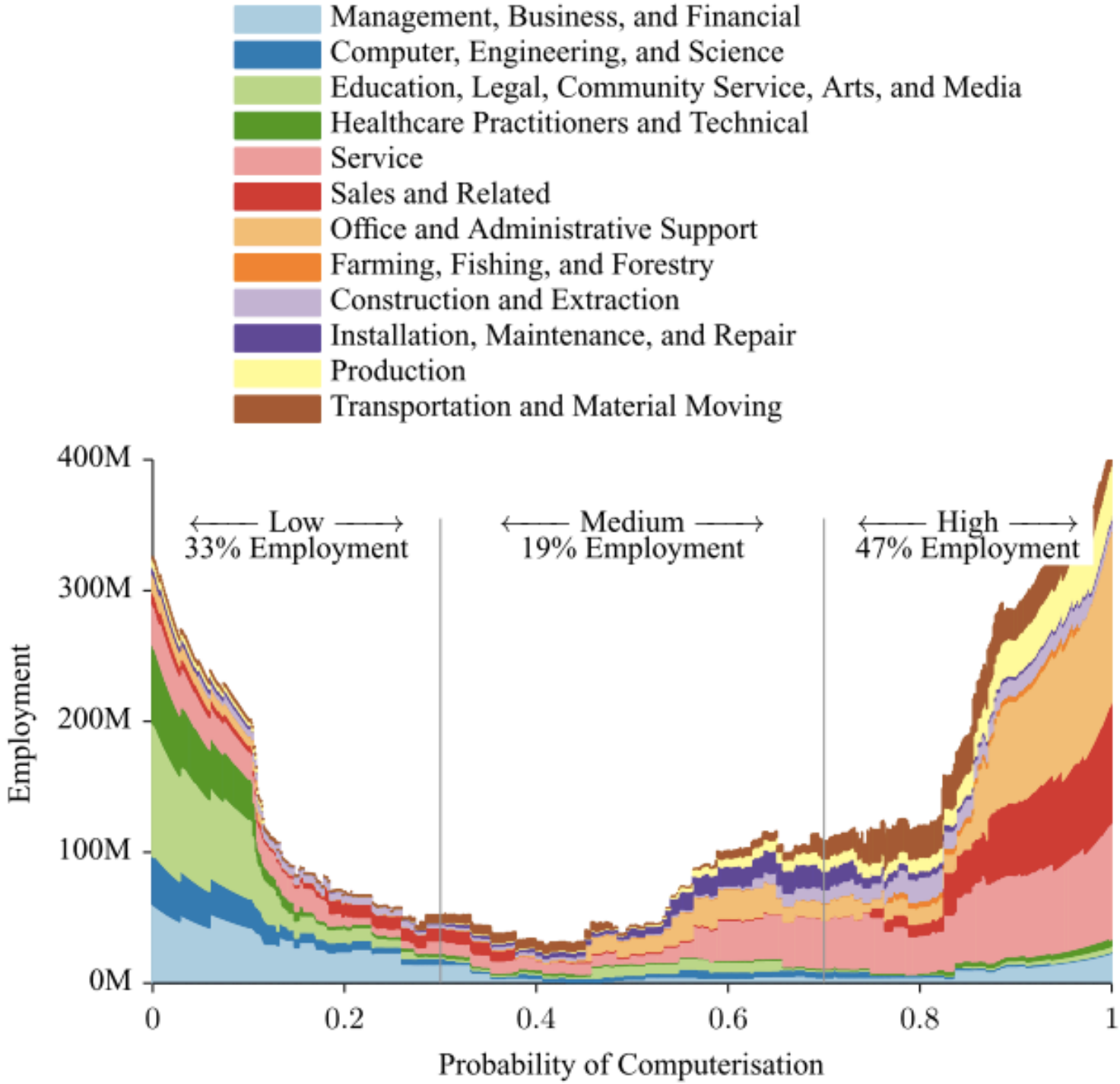
Management, Business, and Financial
Computer, Engineering, and Science
Education, Legal, Community Service, Arts, and Media
Healthcare Practitioners and Technical
Service
Sales and Related
Office and Administrative Support
Farming, Fishing, and Forestry
Construction and Extraction
Installation, Maintenance, and Repair
Production
Transportation and Material Moving
400M
300M
200M
100M
0M
Employment
Low
33% Employment
Medium
19% Employment
High
47% Employment
0
0.2
0.4
0.6
0.8
1
Probability of Computerisation

Technology change in driving

- Changing nature of driving

- Changing tools to understanding driving

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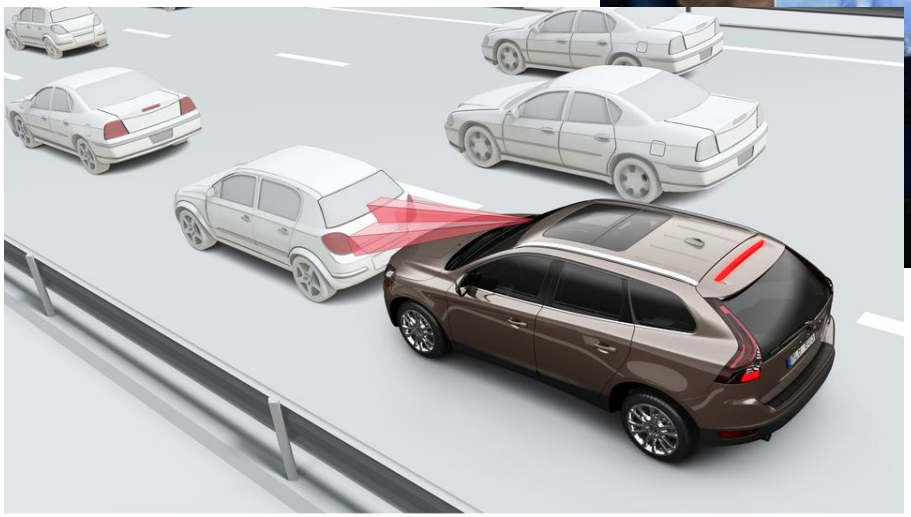
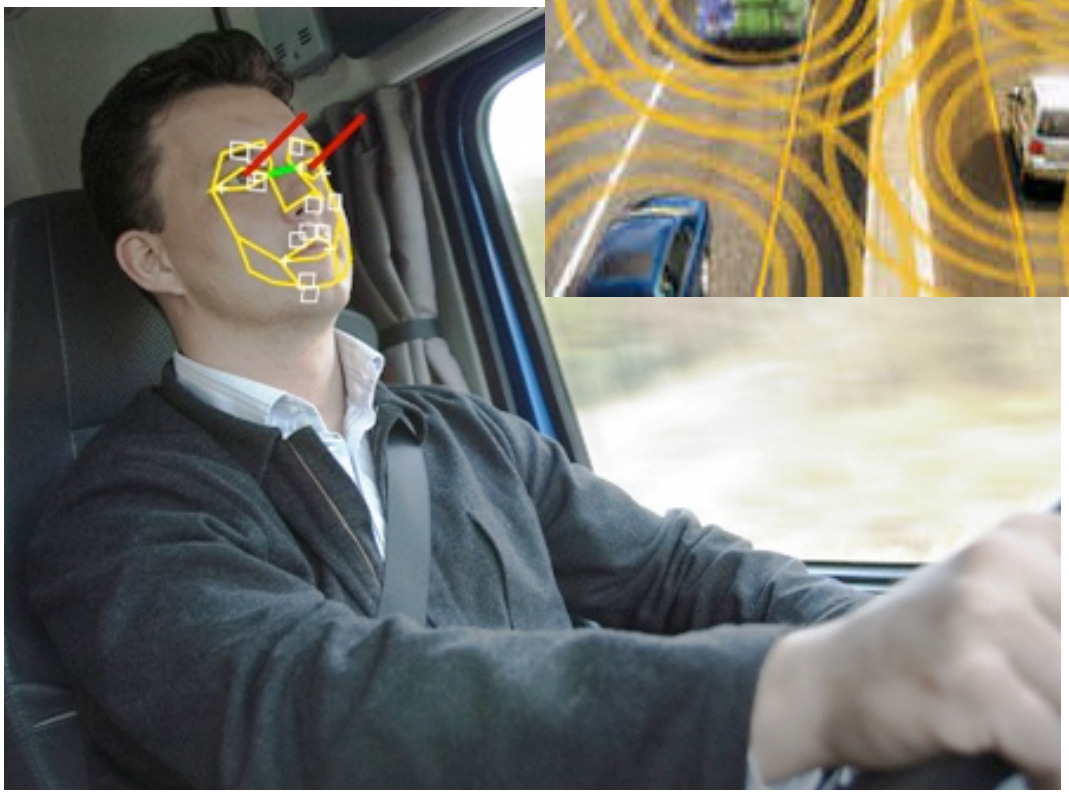
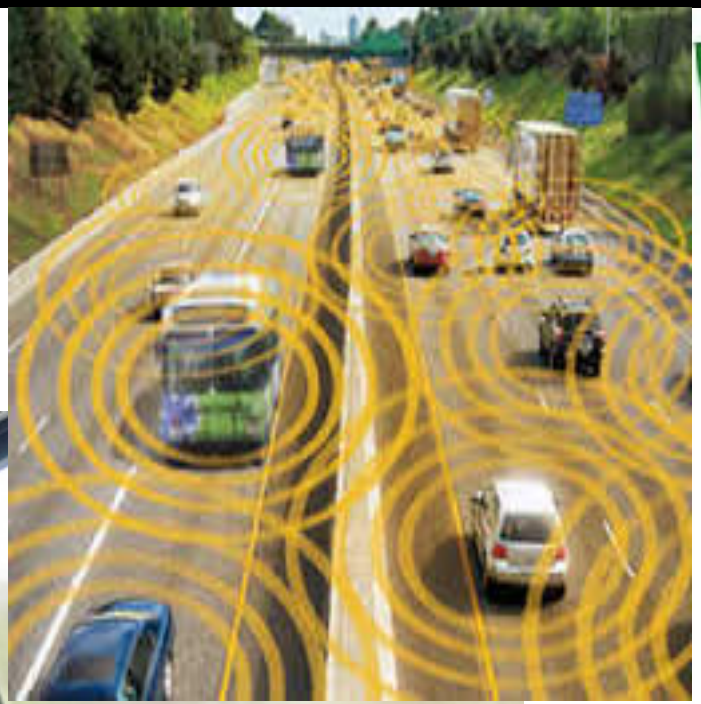
The Good, the Bad, and the Uncertain of Technology

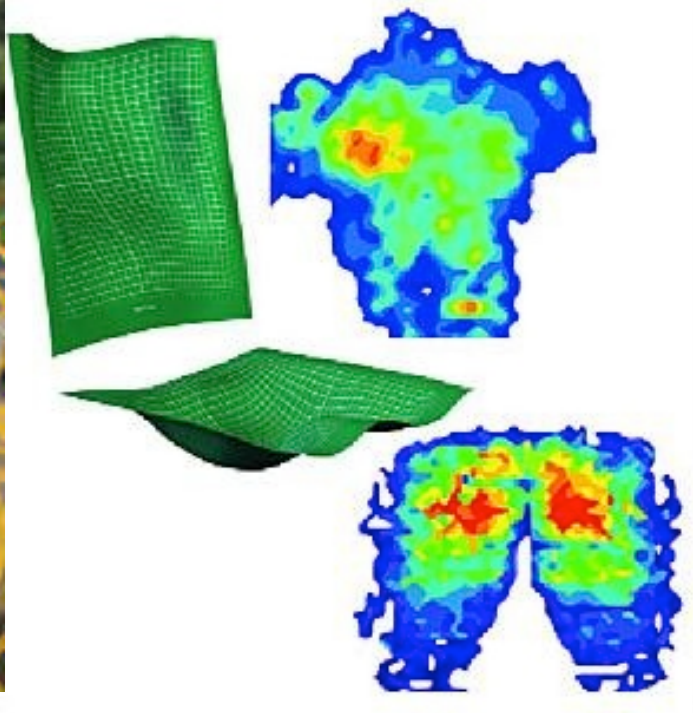
- Safety technology—Huge benefits
- Distracting technology—A major threat
- Autonomous driving—Potentially very good or bad



The good: Safety systems that attend to the driver and road







The bad:
Rapidly evolving distractions

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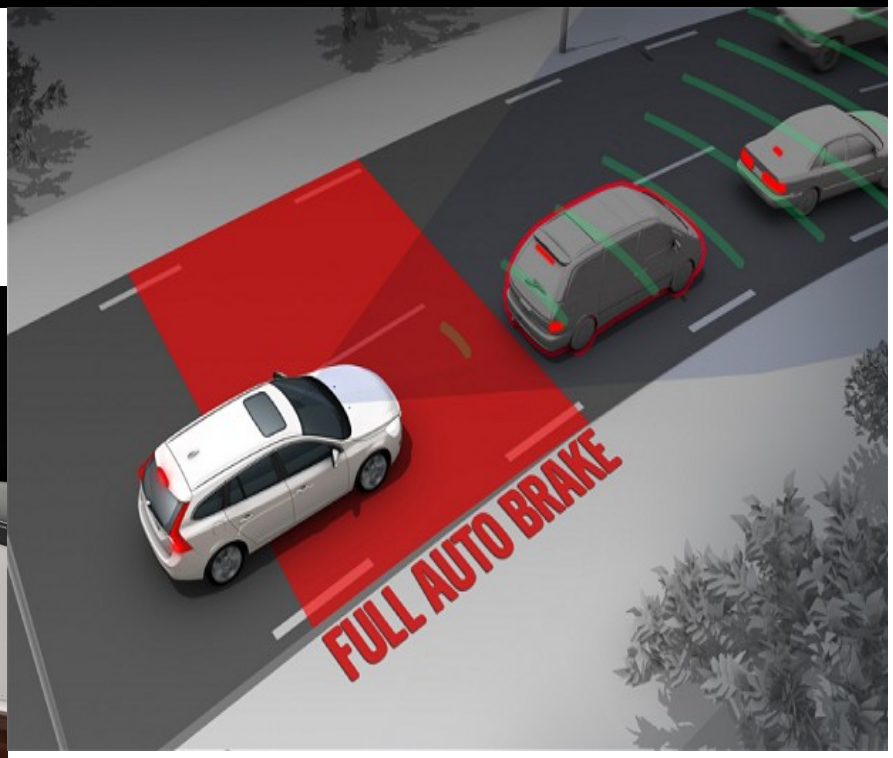
The uncertain:
Increasingly autonomous vehicles

Mercedes 2014 S Class
Semi-autonomous driving



Volvo's City Safe auto braking

Technology to understand driving

- **Reducntionistic—Simulator and controlled laboratory studies**
- Naturalistic—Data collected from daily driving
- Opportunistic—Data from non-traditional sources, such as Twitter

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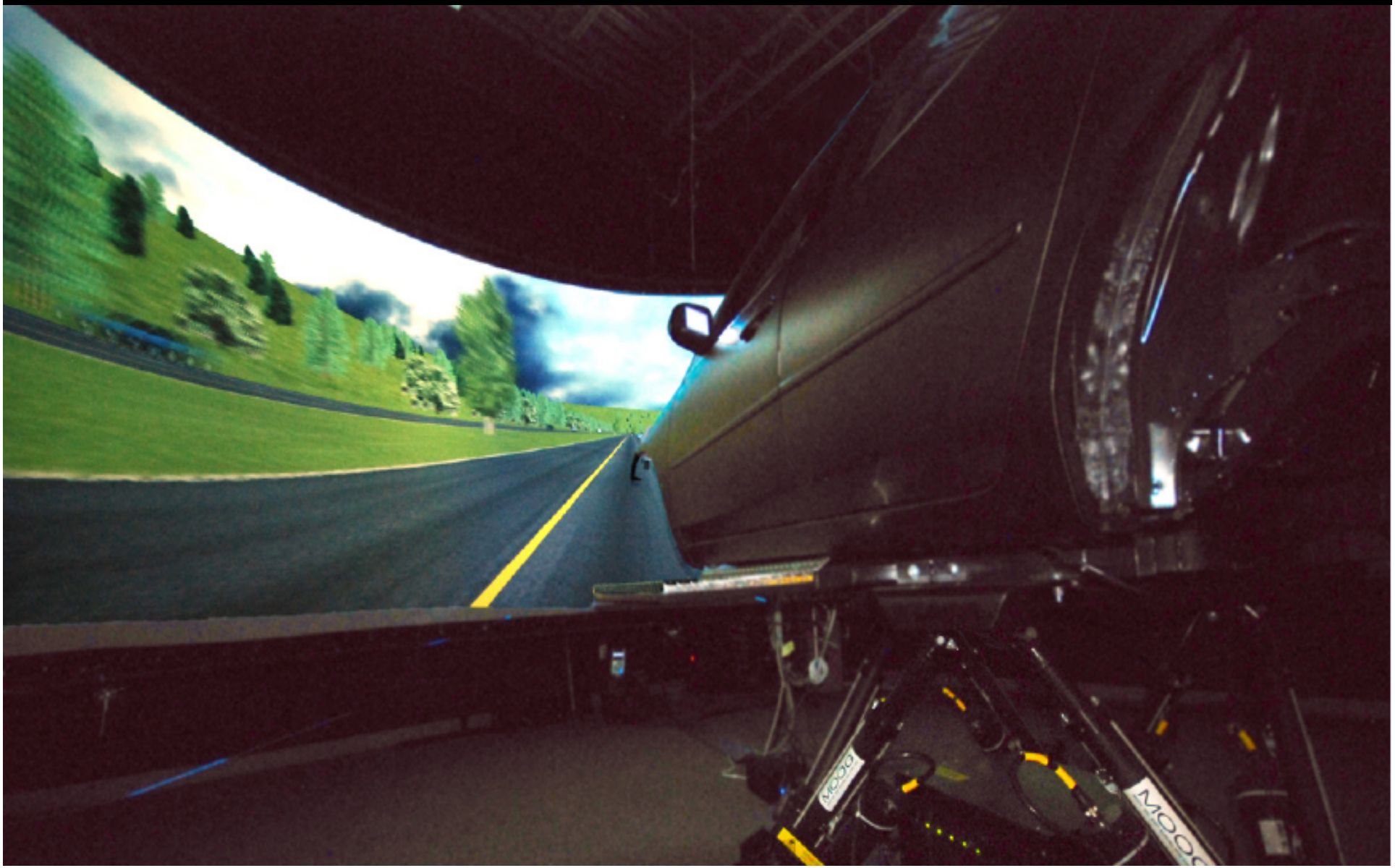
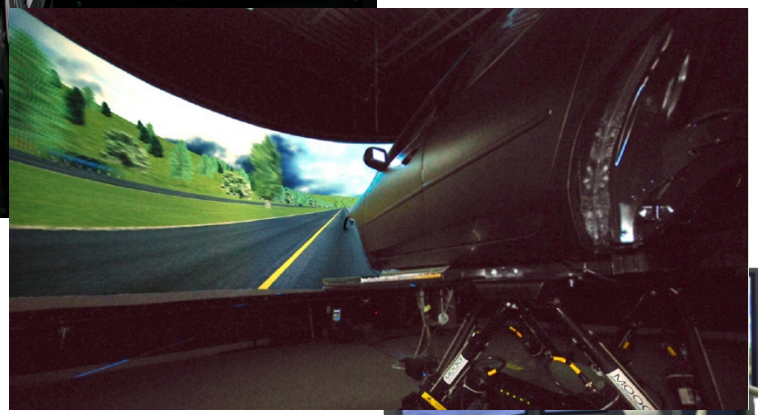
Reductionistic:
Driving simulator study of road designs



Increasingly capable simulators



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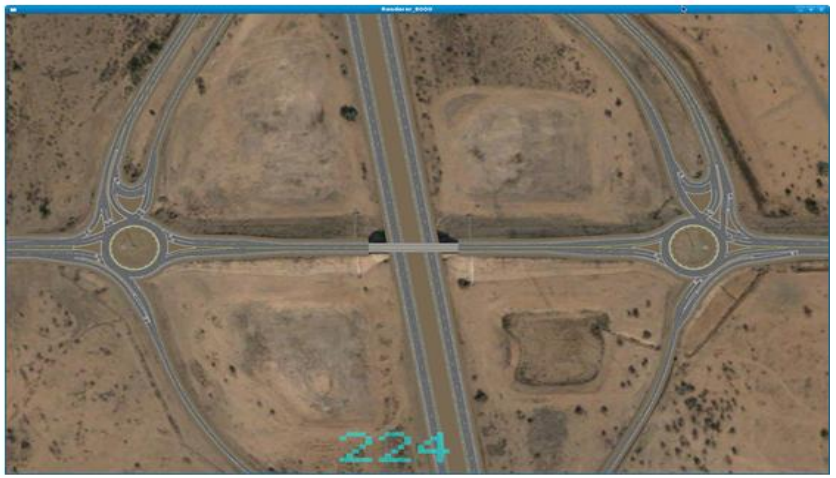
Exact replication of geometry

MD Roundabout – Real
(Google Earth, 2002)

MD Roundabout – Simulated

AZ Roundabout – Real
(Google Earth, 2002)



AZ Roundabout – Simulated

Realistic rendering of road scene

MD Roundabout – Real

MD Roundabout – Simulated

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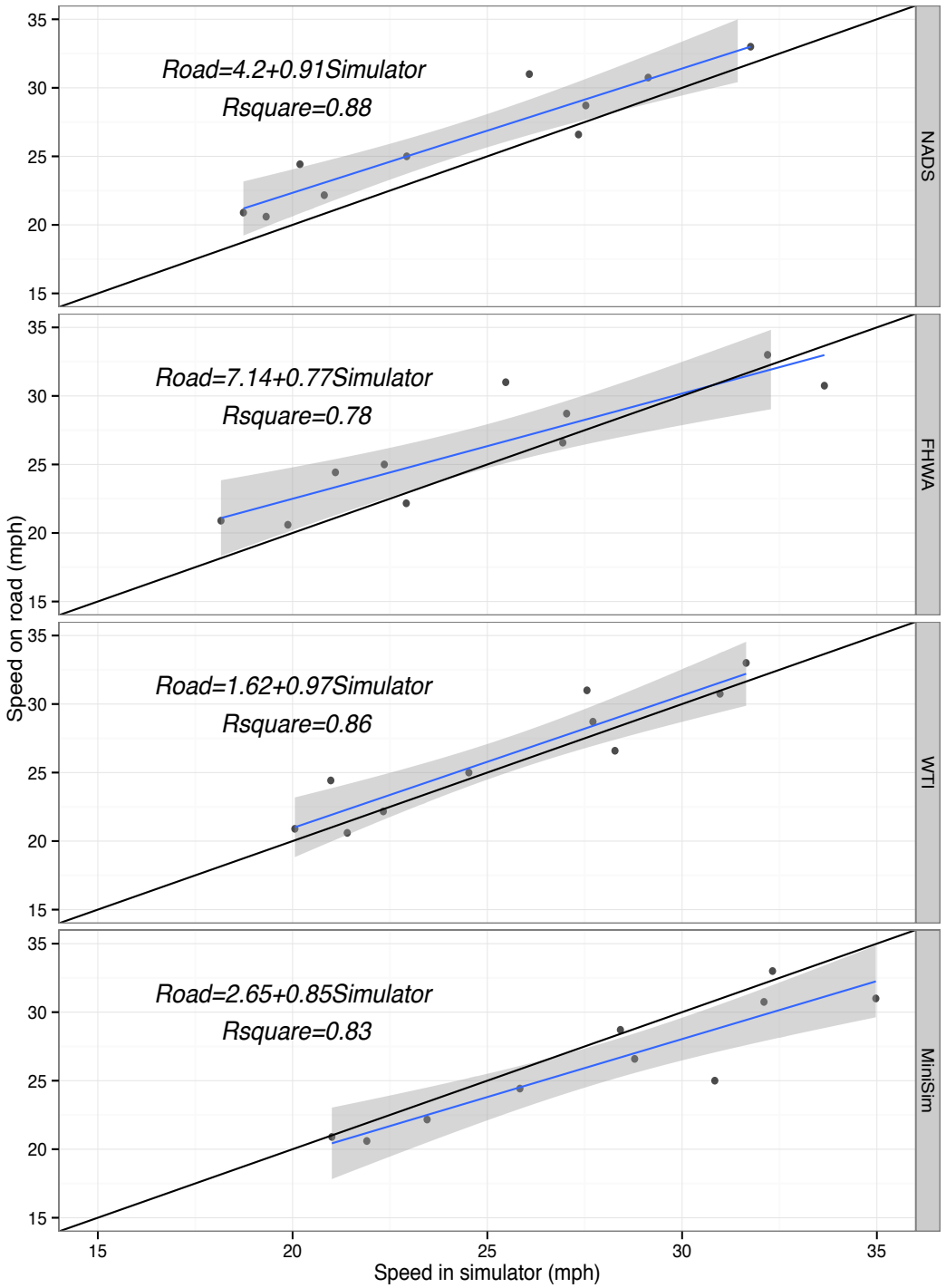
Matches behavior observed on the road



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Distraction in a driving simulator

Taylor, Roman, McFeaters, Romoser, Borowsky, Merritt, Pollatsek, Lee and Fisher (In review)

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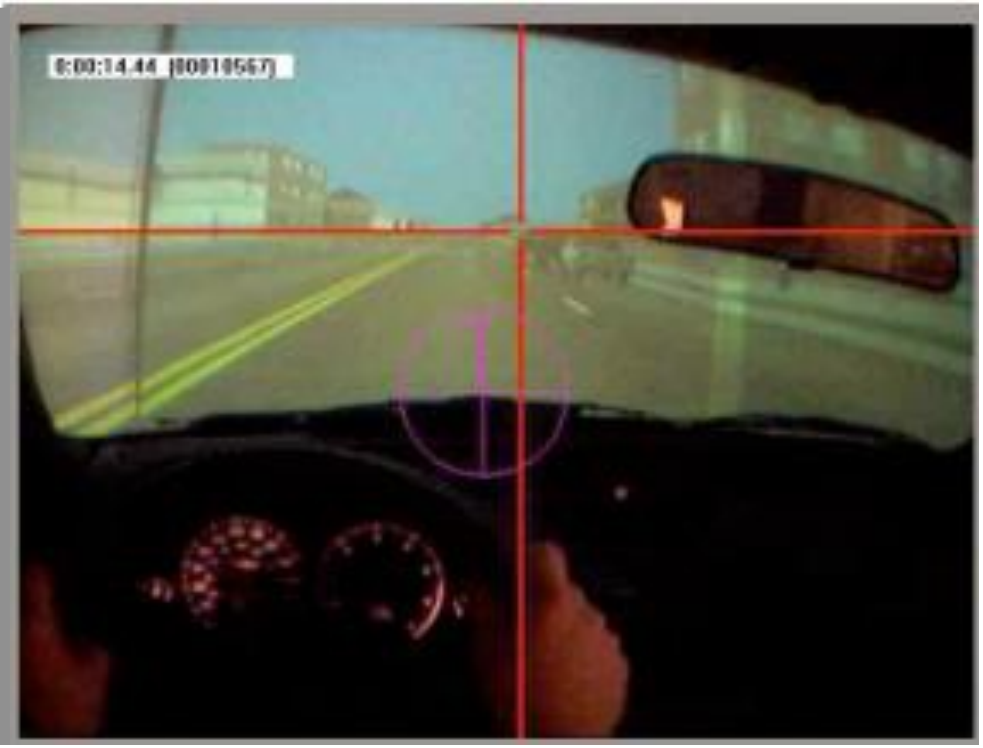
Cellphones cause drivers to neglect hazards

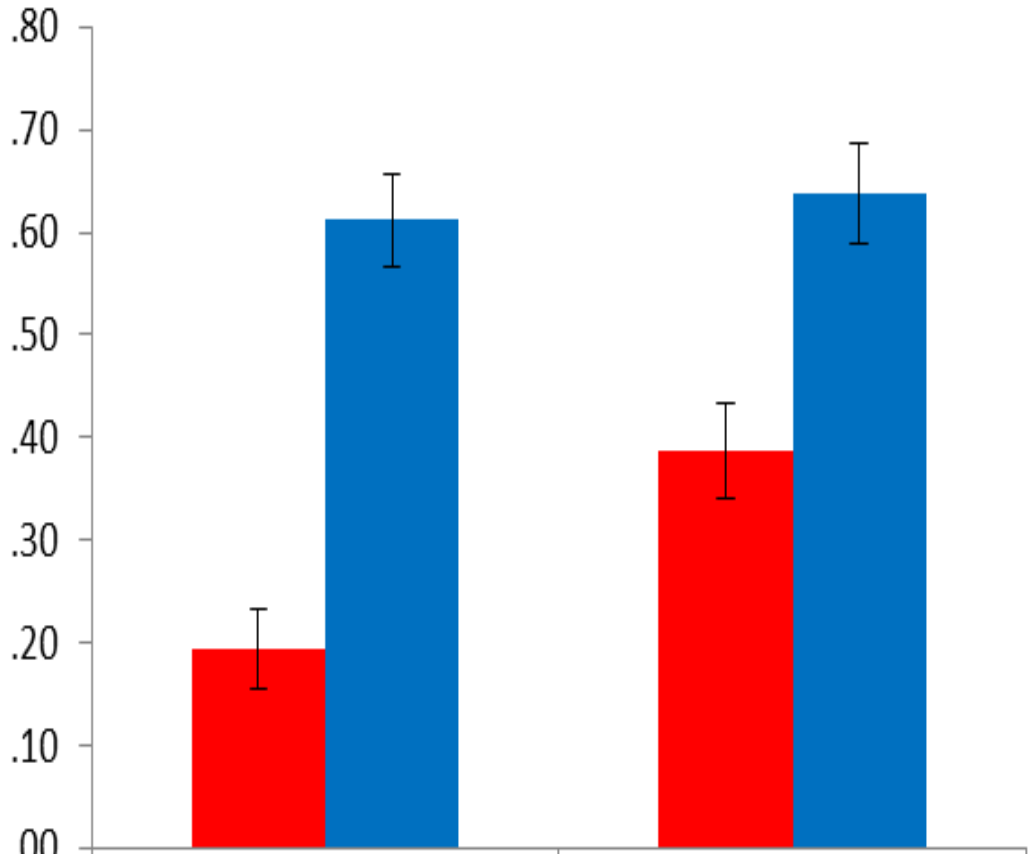
	With cellphone	Without cellphone
Left side of cross walk hidden by traffic	21.4%	92.9%
Fresh green light	14.3%	21.4%

16 other similar events



Portion of drivers glancing to hazard

Drivers on cellphone frequently fail to look towards hazards



	No Intersection	Intersection
With Cellphone	.19	.39
Without Cellphone	.61	.64

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Technology to understand driving

- Reductionistic—Simulator and controlled laboratory studies
- **Naturalistic—Data collected from routine driving**
- Opportunistic—Data from non-traditional sources, such as Twitter

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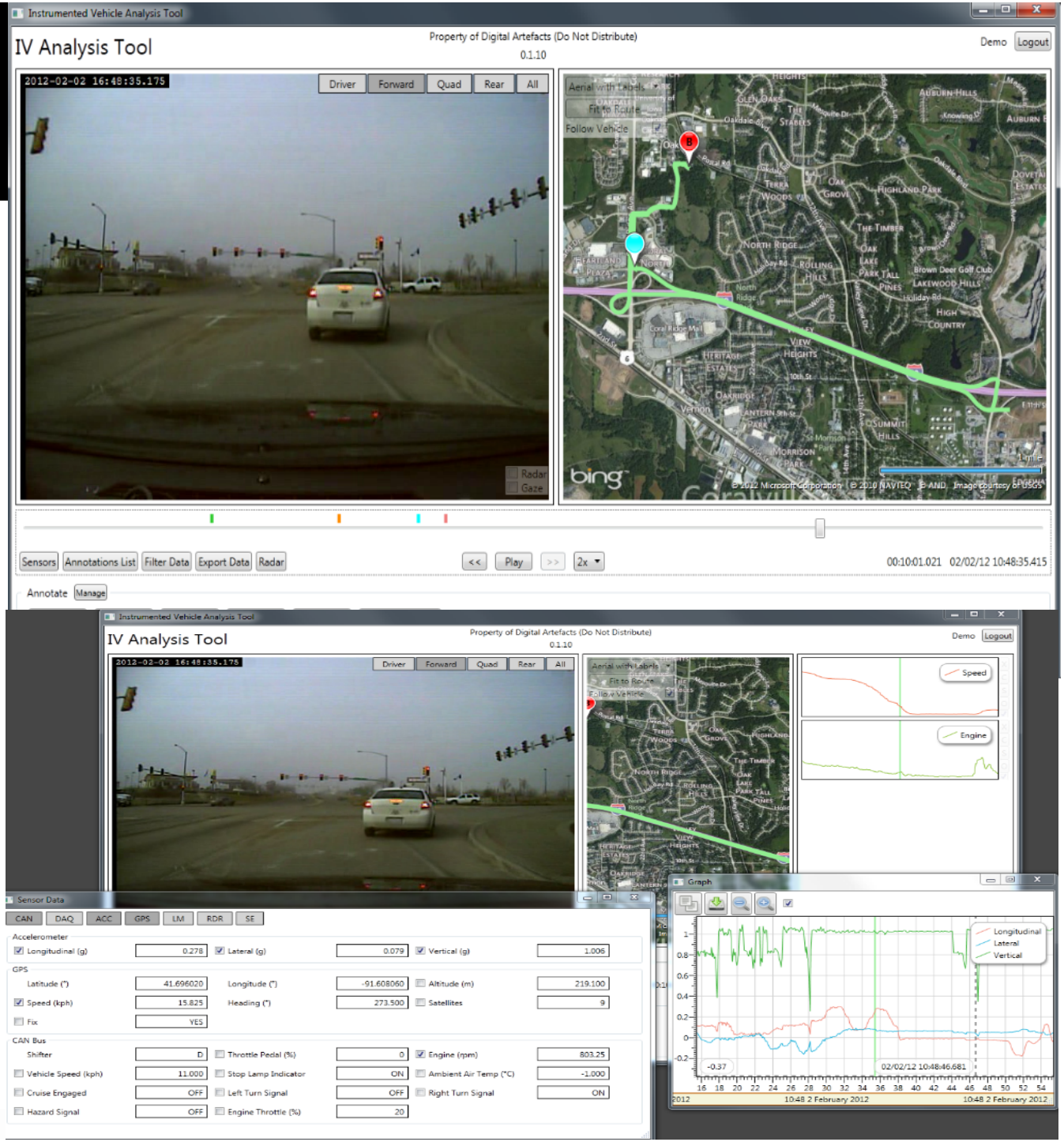
Naturalistic data to understand distraction



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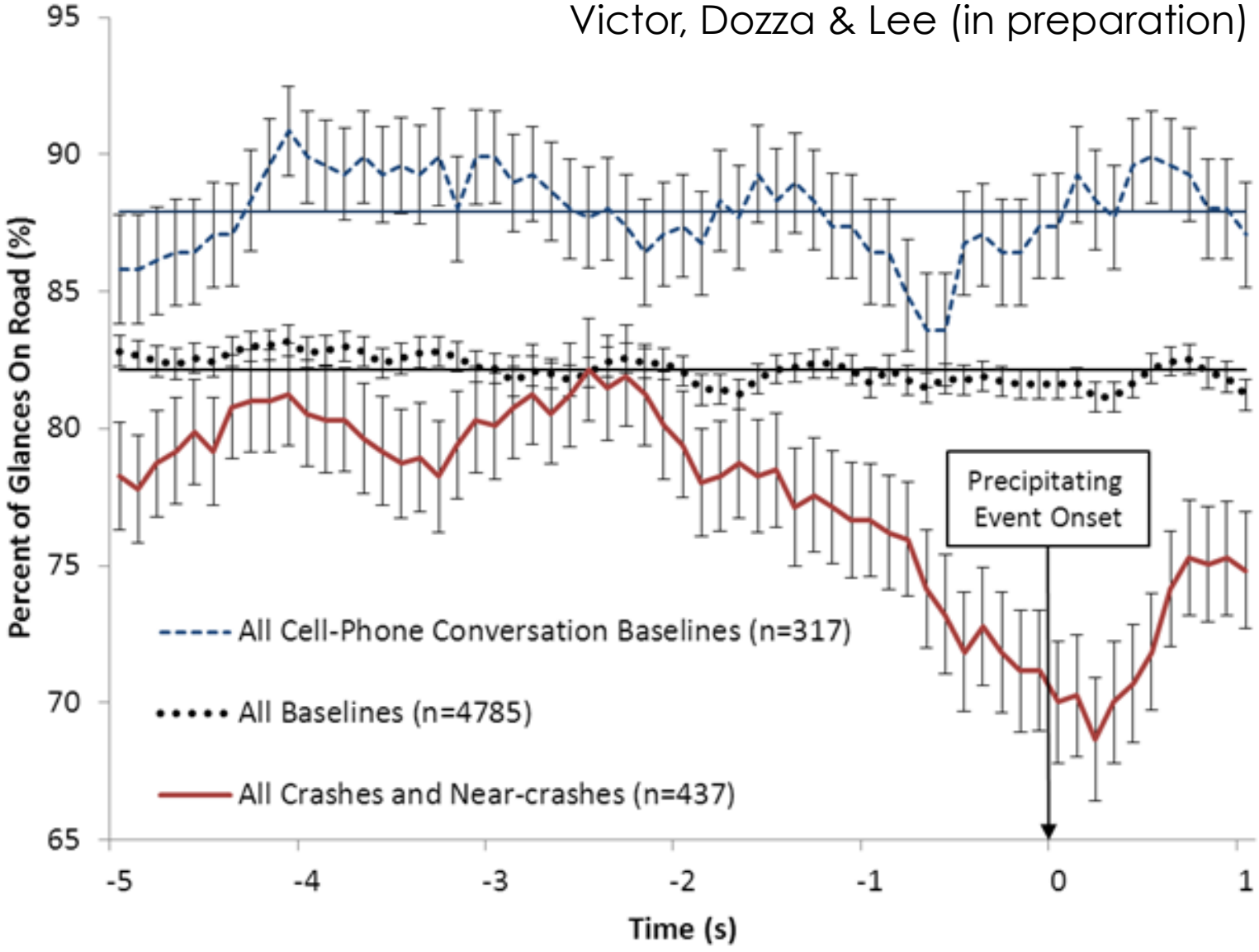
Attention to the road in naturalistic driving

Victor, Dozza & Lee (in preparation)



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Automatic eye, head, and hand coding

- Frame-by-frame coding millions of hours of video data???
- Image processing and machine learning for semi-automatic coding

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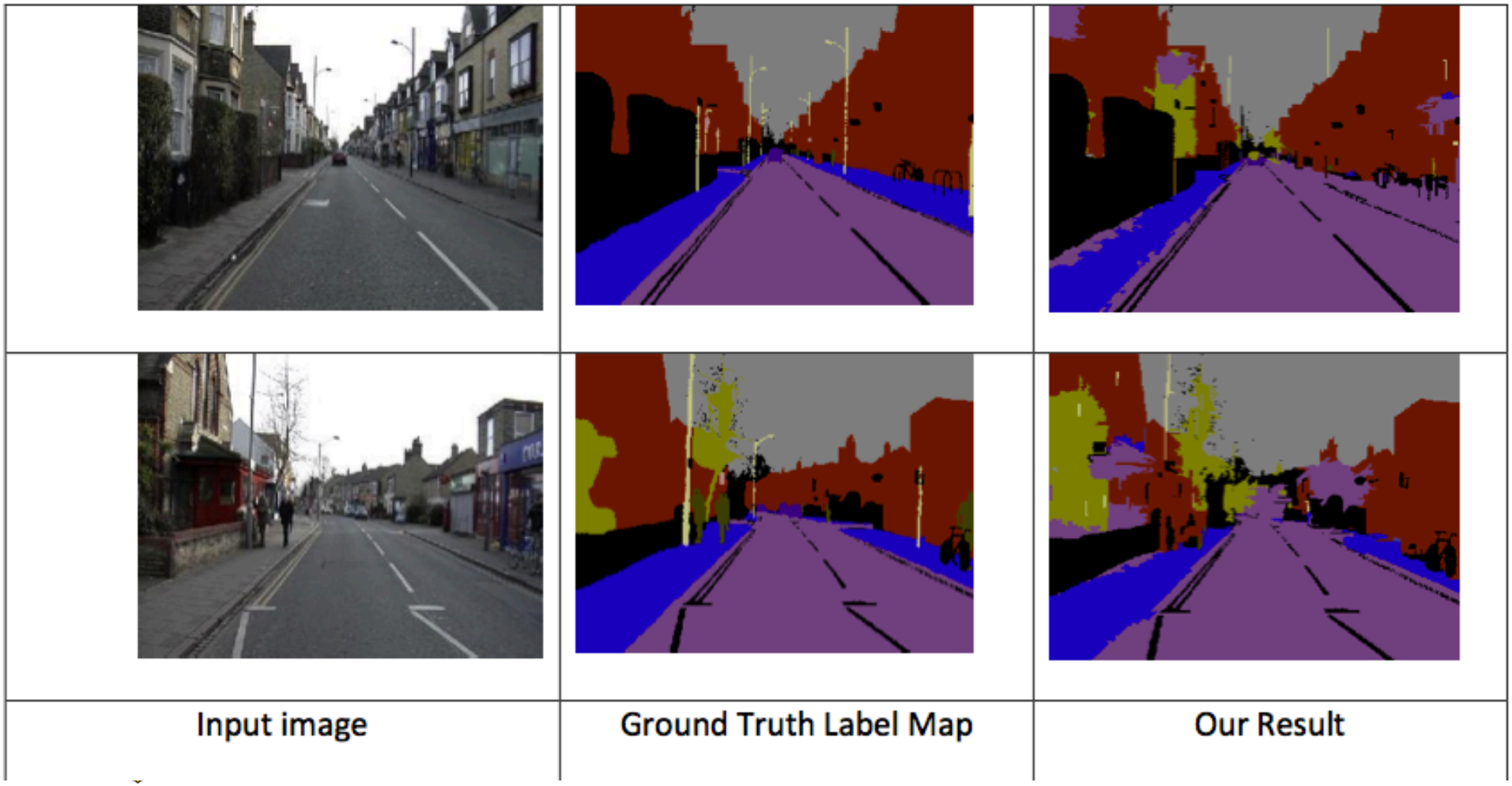
Road scene coding



Input image	Ground Truth Label Map	Our Result

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Technology to understand driving

- Reductionistic—Simulator and controlled laboratory studies
- Naturalistic—Data collected from daily driving
- **Opportunistic—Data from non-traditional sources, such as Twitter**

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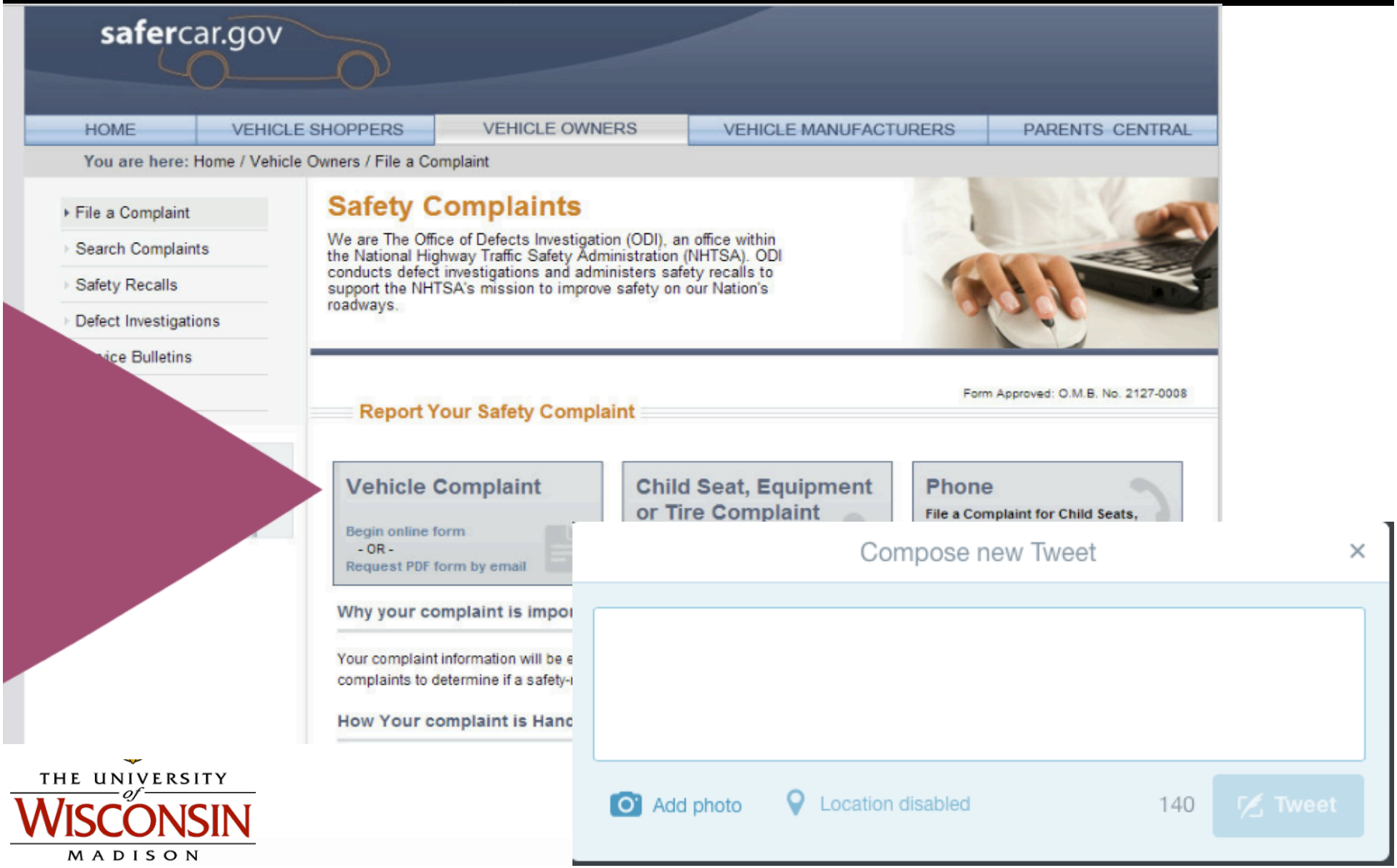
Drivers as sensors: complaint and twitter data



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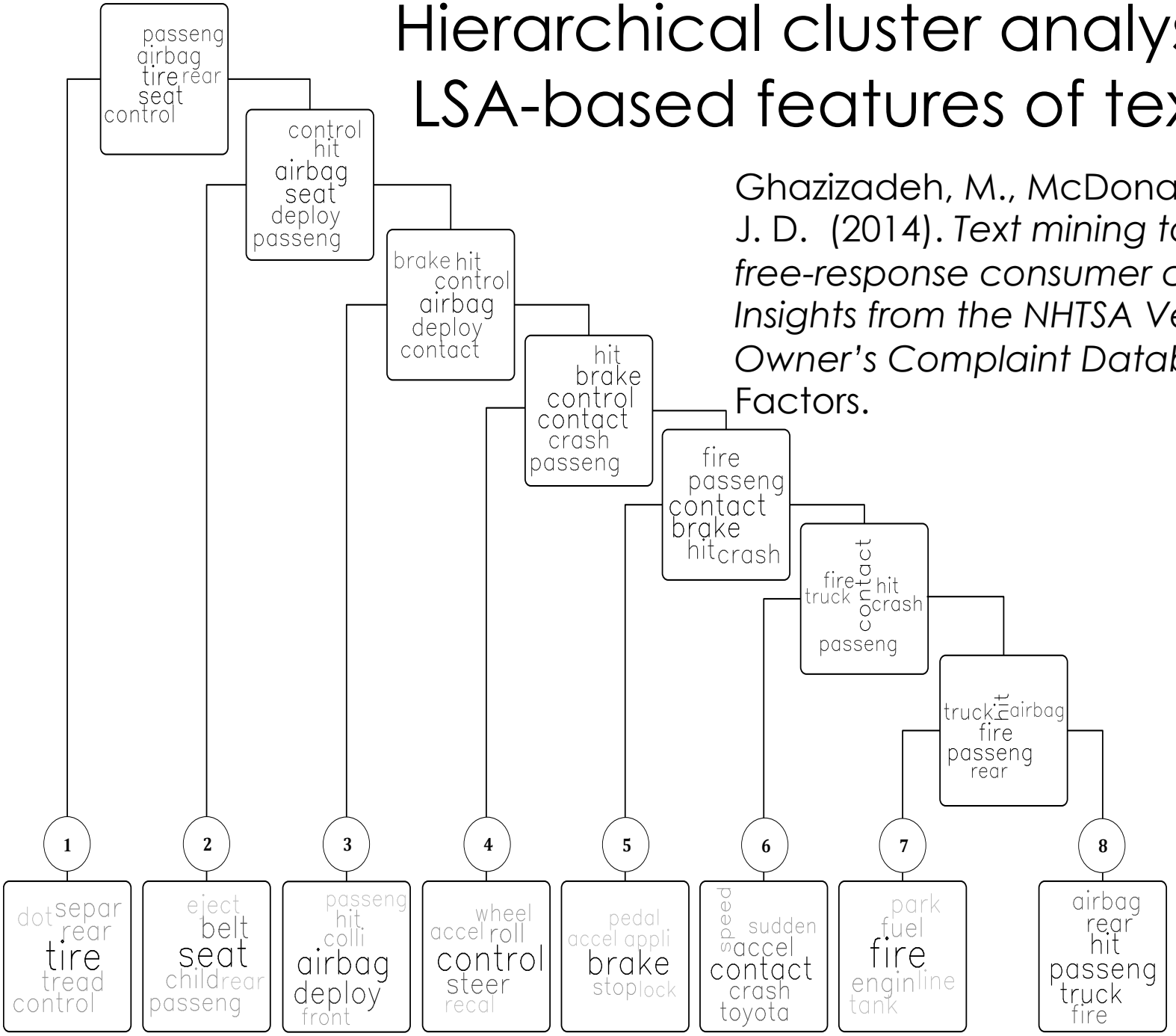
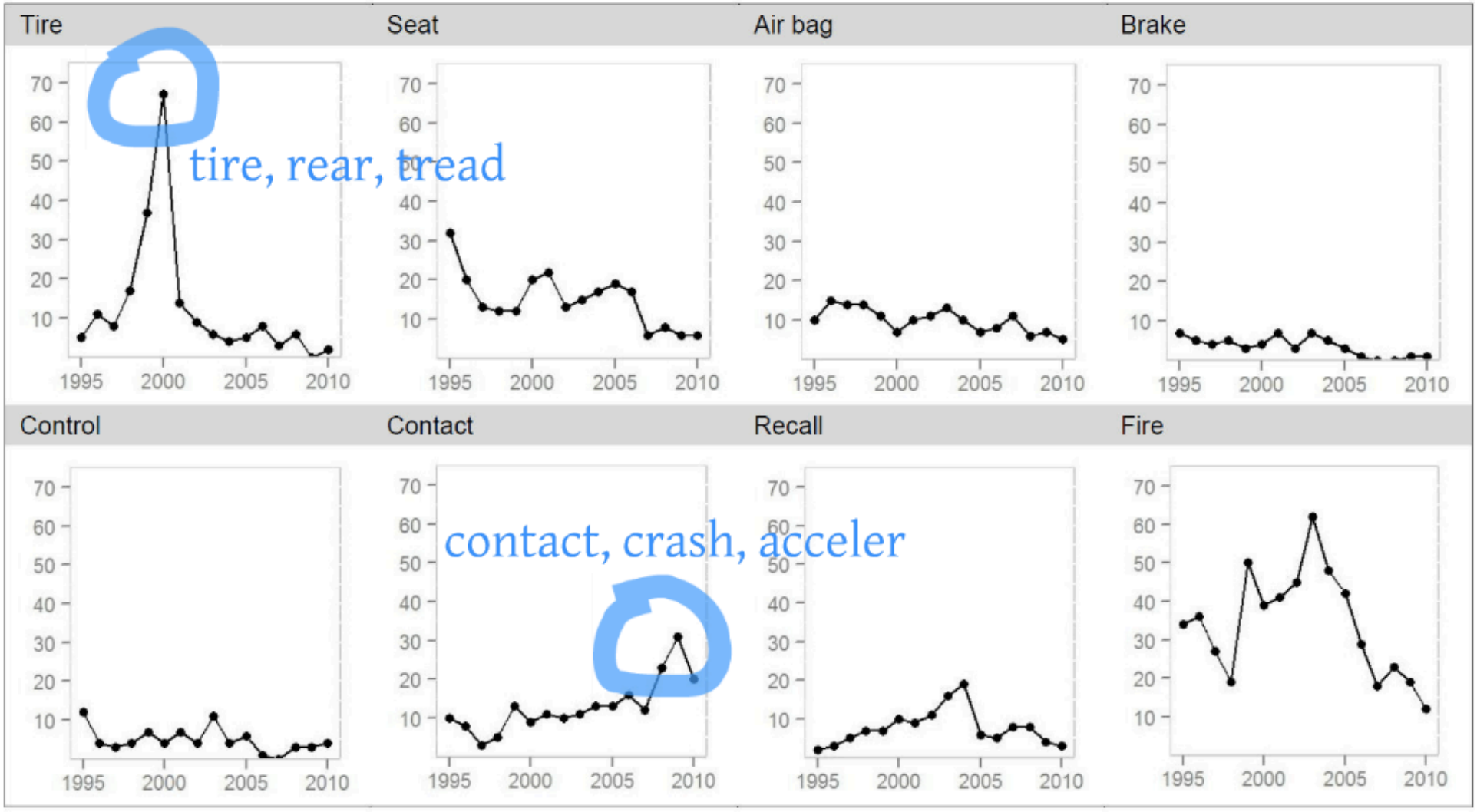
Hierarchical cluster analysis using LSA-based features of text



Ghazizadeh, M., McDonald, T. D., Lee, J. D. (2014). *Text mining to decipher free-response consumer complaints: Insights from the NHTSA Vehicle Owner's Complaint Database*. Human Factors.

Trend of complaint clusters



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Drivers as sensors: Twitter data

"I saw a dead crow on its back in the road. It was a bit SPLAT! I thought it had fallen out of the sky."
Created at: 2012-09-26 17:35:23
Location: Madison, WI

Xu, J., Bhargava, A., Nowak, R., & Zhu, X. (2012). Socioscope: Spatio-Temporal Signal Recovery from Social Media. Machine Learning and Knowledge 3096–3100.

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Drivers as sensors: Twitter data

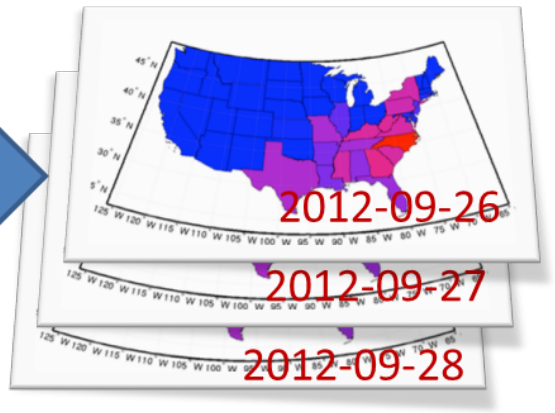
- Spatio-temporal Signal: When, Where, How Much
- Simple estimation does not consider
  - Population bias, Imprecise location, Low counts
- Socioscope precisely recovers the intensity of pre-defined target phenomena

Text Pre-process

Time	Location
2012-09-26 17:35:23	Wisconsin US
2012-09-27 12:17:52	N/A
2012-09-27 08:28:12	(-98.24, 23.22)
...	

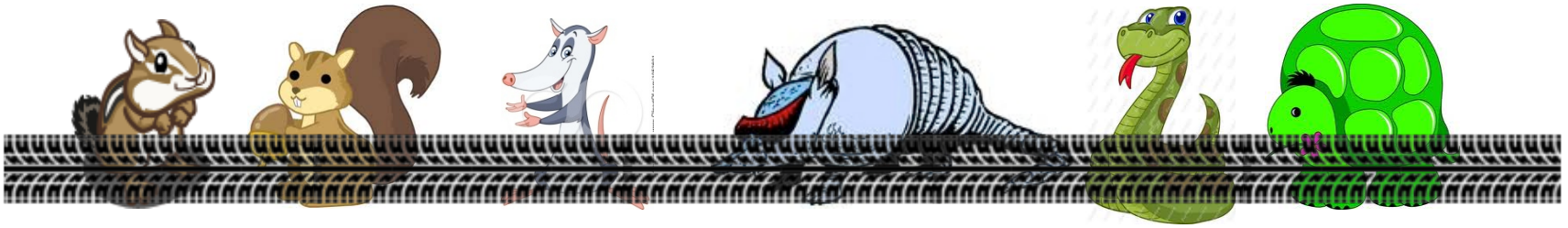
Socio-scope

Spatio-temporal signal



Socioscope case study: Roadkill

The intensity of roadkill events across the continental US



- Spatio-Temporal resolution:

  State: 48 continental US states, hour-of-day: 24 hours

- Text classifier:
  - Trained with 1450 labeled tweets
  - CV accuracy 90%

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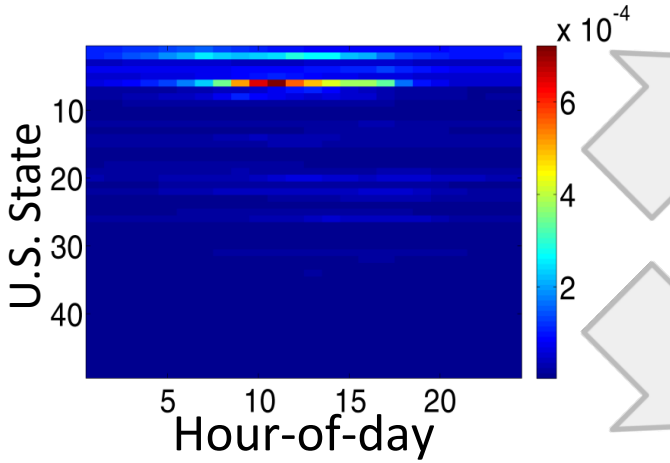
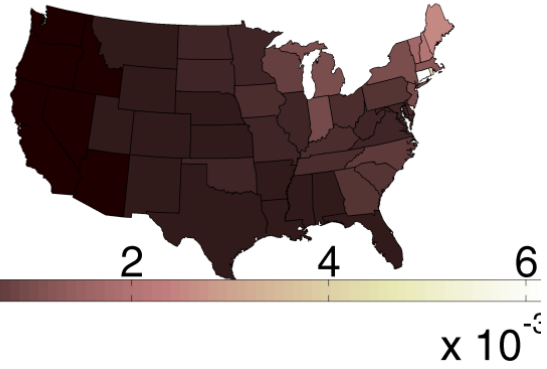
Xu, J., Bhargava, A., Nowak, R., & Zhu, X. (2012). Socioscope: Spatio-Temporal Signal Recovery from Social Media. Machine Learning and Knowledge 3096–3100.

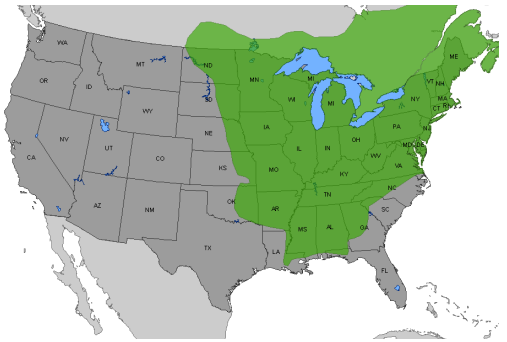
Chipmunk roadkill



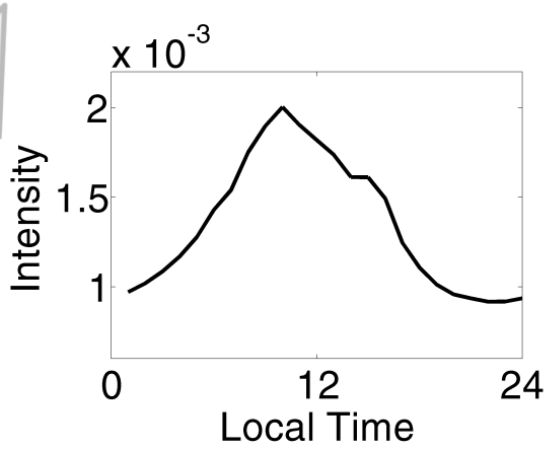
Spatio-temporal distribution
Recovered by Socioscope



Socioscope – Spatial



Range Map



Socioscope – Temporal

"Chipmunks are diurnal"

Activity Pattern

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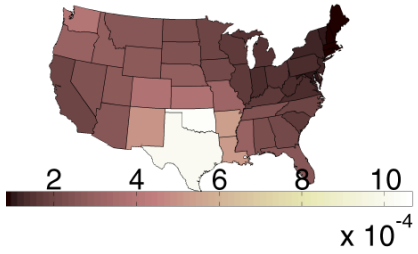
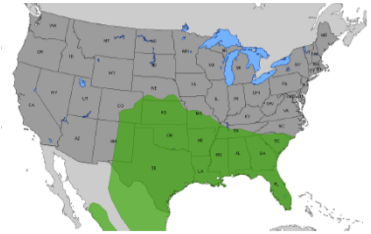
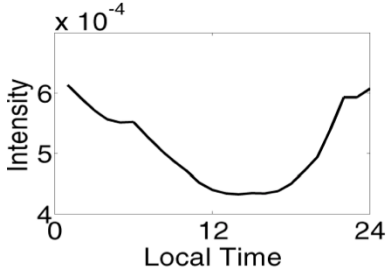
Roadkill analysis of other species

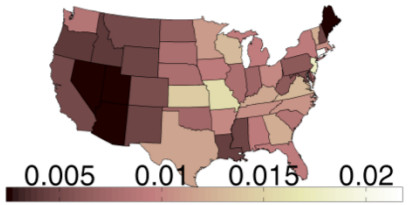


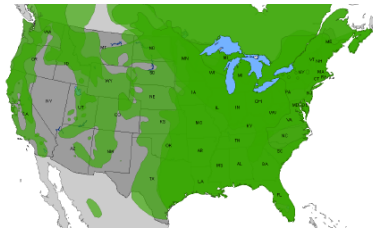


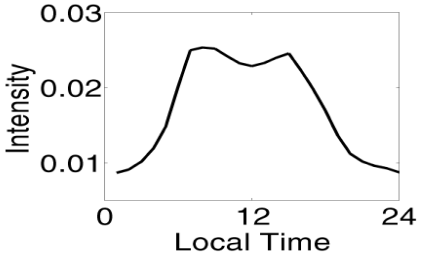


"Armadillos are nocturnal"

Armadillos

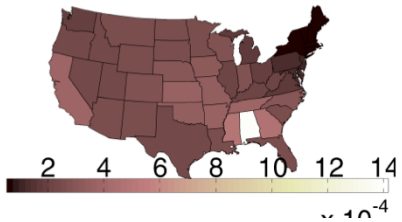


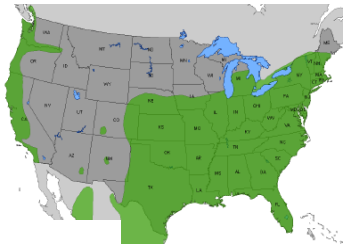


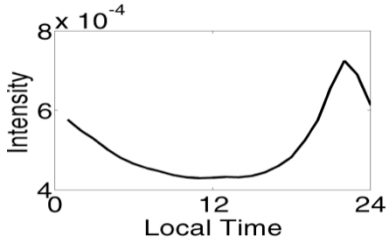


"Most squirrels are diurnal"

Squirrels







"Opossums are nocturnal"

Opossums

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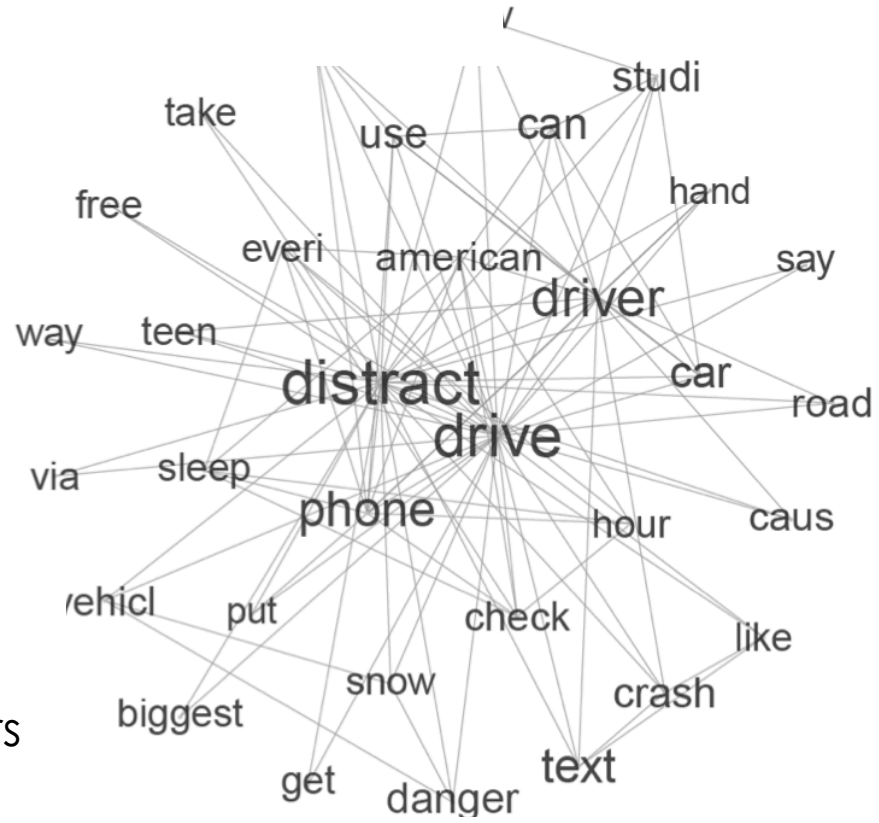
Driver distraction-related tweets

[Name] tells me that I can't listen to music while driving cause it's a distraction. I think he's jealous of my amazing singing voice.

Raise your hand and take the pledge to do your part to end distracted driving on our roads [link to website].



Roberts, S. C., & Lee, J. D. (2014). *Deciphering 140 Characters: Text mining tweets on #DriverDistraction.* Human Factors and Ergonomics Society Annual Meeting.

Tracking automation surprises with complaint data and Twitter?

- Mode confusion with push-button start and beyond
- CO asphyxiation in forgetting to turn of the vehicle

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Technology to understand driving technology

- Reductionistic—Simulator and controlled laboratory studies
- Naturalistic—Data collected from daily driving
- Opportunistic—Data from non-traditional sources, such as Twitter

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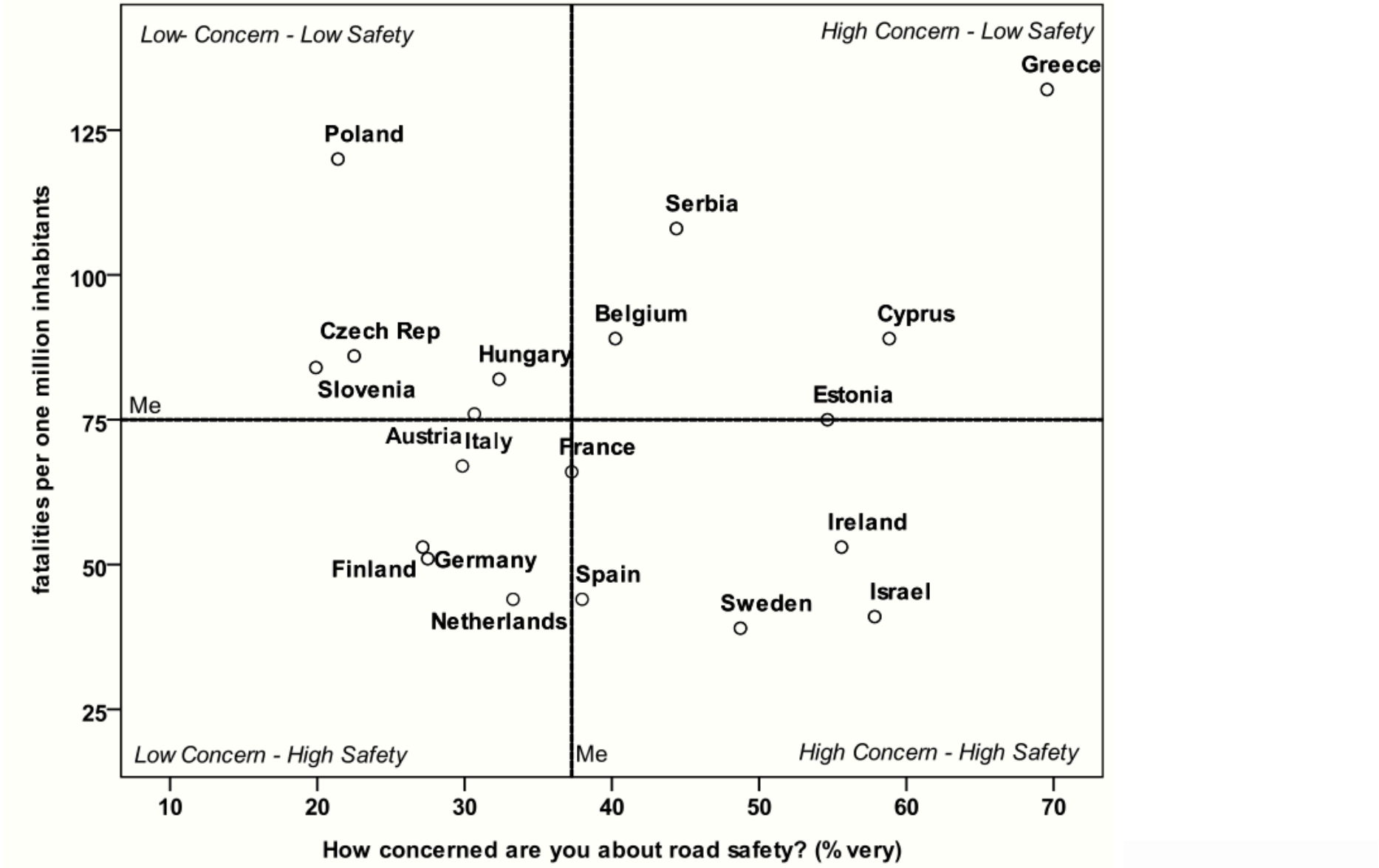
ABBA and safety culture

SARTRE
Attitudes about road safety



Technology Trends and Traffic Safety

- More change in driving in next 5 years than previous 50
- The good, the bad, and the uncertain of emerging vehicle technology
- Reductionistic, Naturalistic, and Opportunistic safety analysis techniques
- Driver attitudes and adaptation central to safety

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