

Drowsy Driving and Technology: Crash contributions, causes, and countermeasures

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Consequences of Drowsy Driving

- 1550 deaths 3000 deaths? 6000 deaths?
- 40,000 injuries
- 100,000 crashes
- Leaves no trace and so often goes unreported
- 4% of drivers report falling asleep in last 30 days

Contribution of Drowsiness to Crashes

- Diminished executive control—Poor decisions
- Disengagement—Longer reaction times
- Microsleeps and sleep onset—Run off road crashes



Causes of Drowsiness

- Poor sleep
- Time of day, time on task, type of task
- Work and life pressures

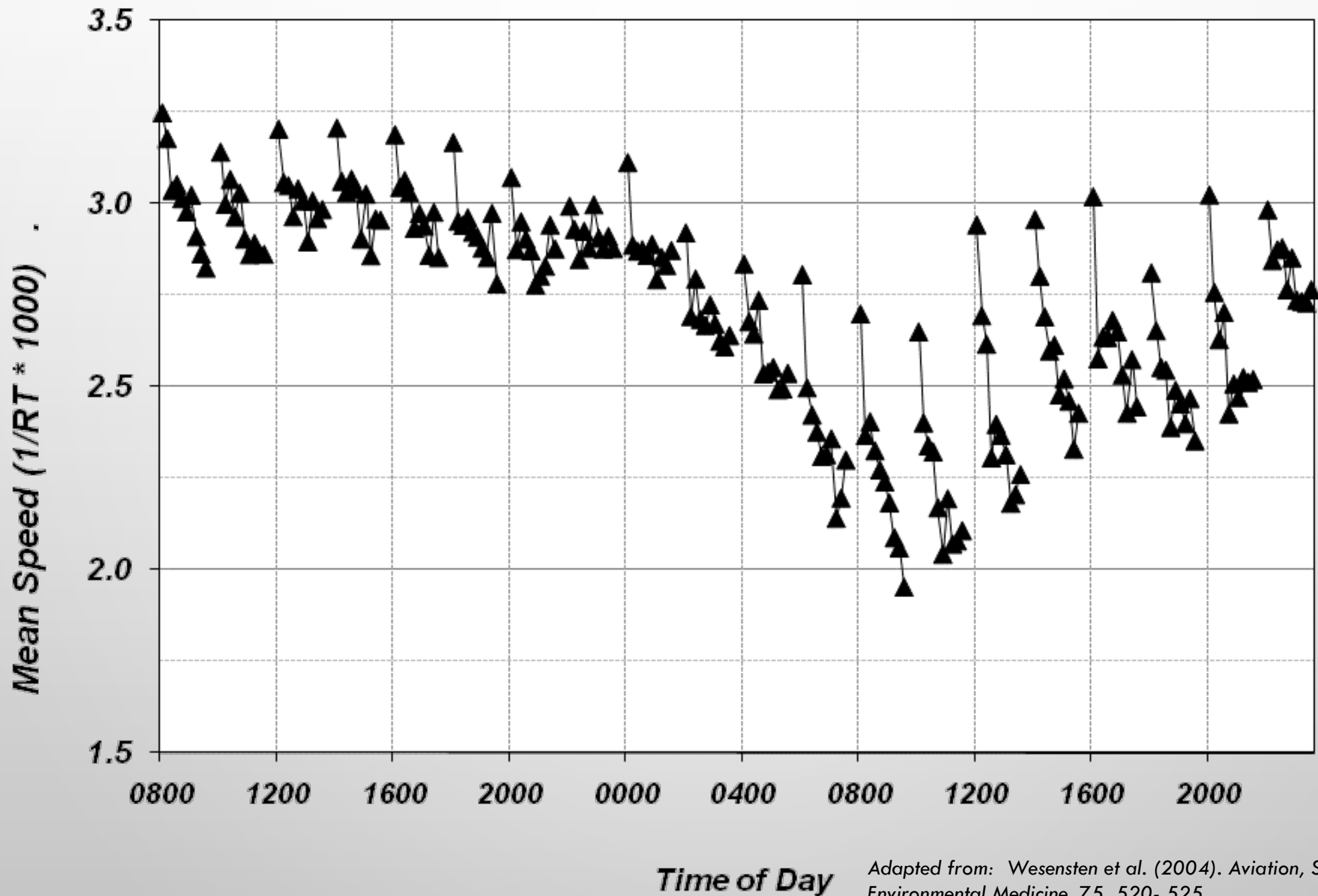


Causes of Drowsiness

- Demographics—Males 16-29 3X
- Sleep duration and quality—6 hours 2X, 5 hours 4X,
Sleep apnea 12X
- Sleep debt—A week of sleeping 4-5 hours a night takes 2 nights to recover
- Time of day—2-6 AM 20X worse than 10AM, 2-4PM
- Time on task—driving more than 90 minutes without a break, 4X
- Monotony—sustained attention to is demanding
- Drug and alcohol magnify drowsiness

Life and job pressures

Circadian rhythm, time on task, time without sleep

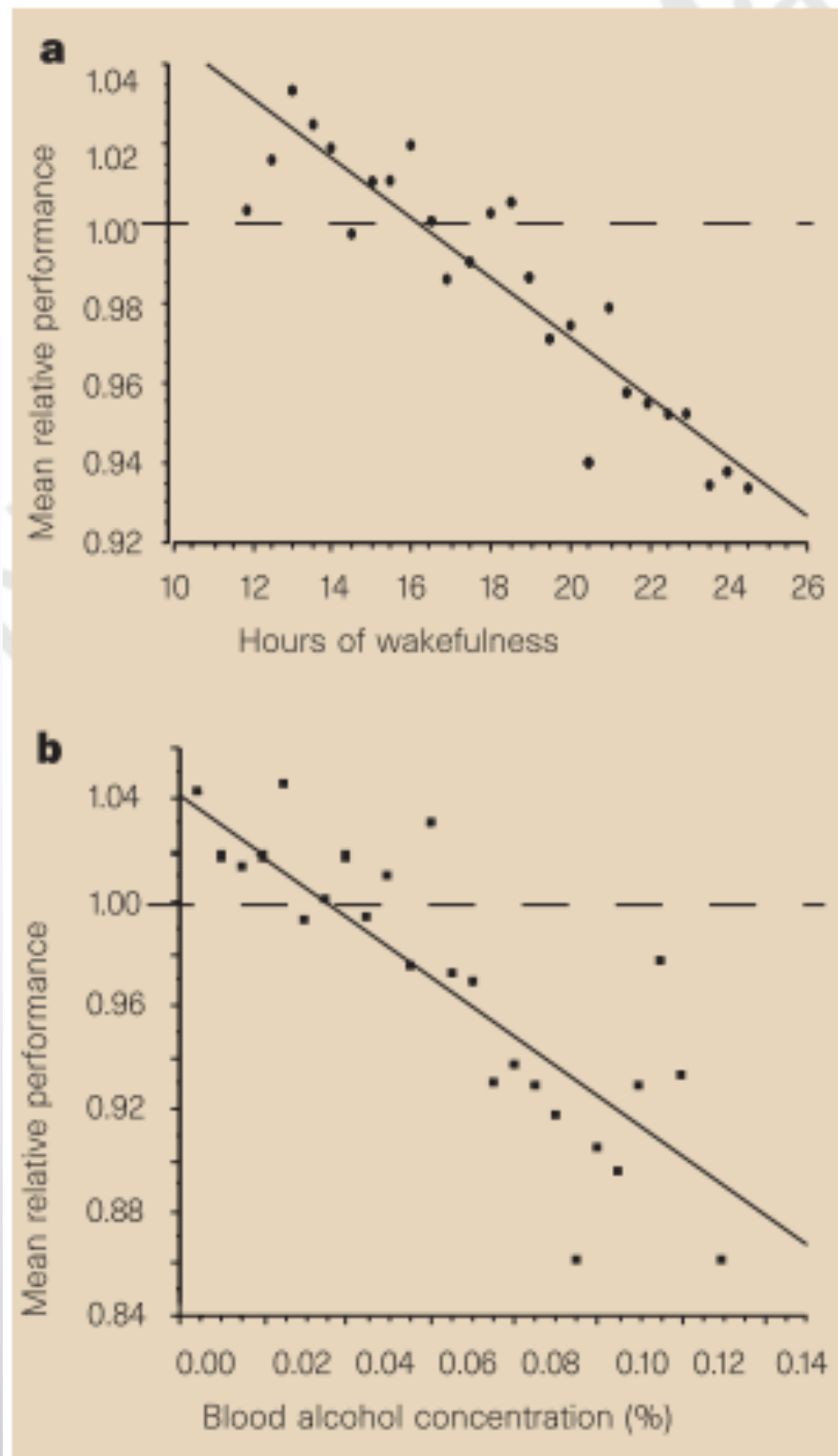


Adapted from: Wesensten et al. (2004). *Aviation, Space, and Environmental Medicine*, 75, 520- 525.

Drowsy Driving Danger

Comparable risk to alcohol intoxication after **18 hours of wakefulness**

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388(6639), 235.



Countermeasures: Technology to the rescue?

- More and better sleep (at least a *regular* 7 hours and at least 8 for teens)
- Sleep rooms in the workplace
- Rest stops: Frequent breaks and caffeinated naps
- Rumble strips
- Driving with a responsible partner
- Alertness monitor—vehicle as partner
- Vehicle emergency control
- Smart environment and coaching
- Self-driving vehicles



Simple and Effective: Rumble strips

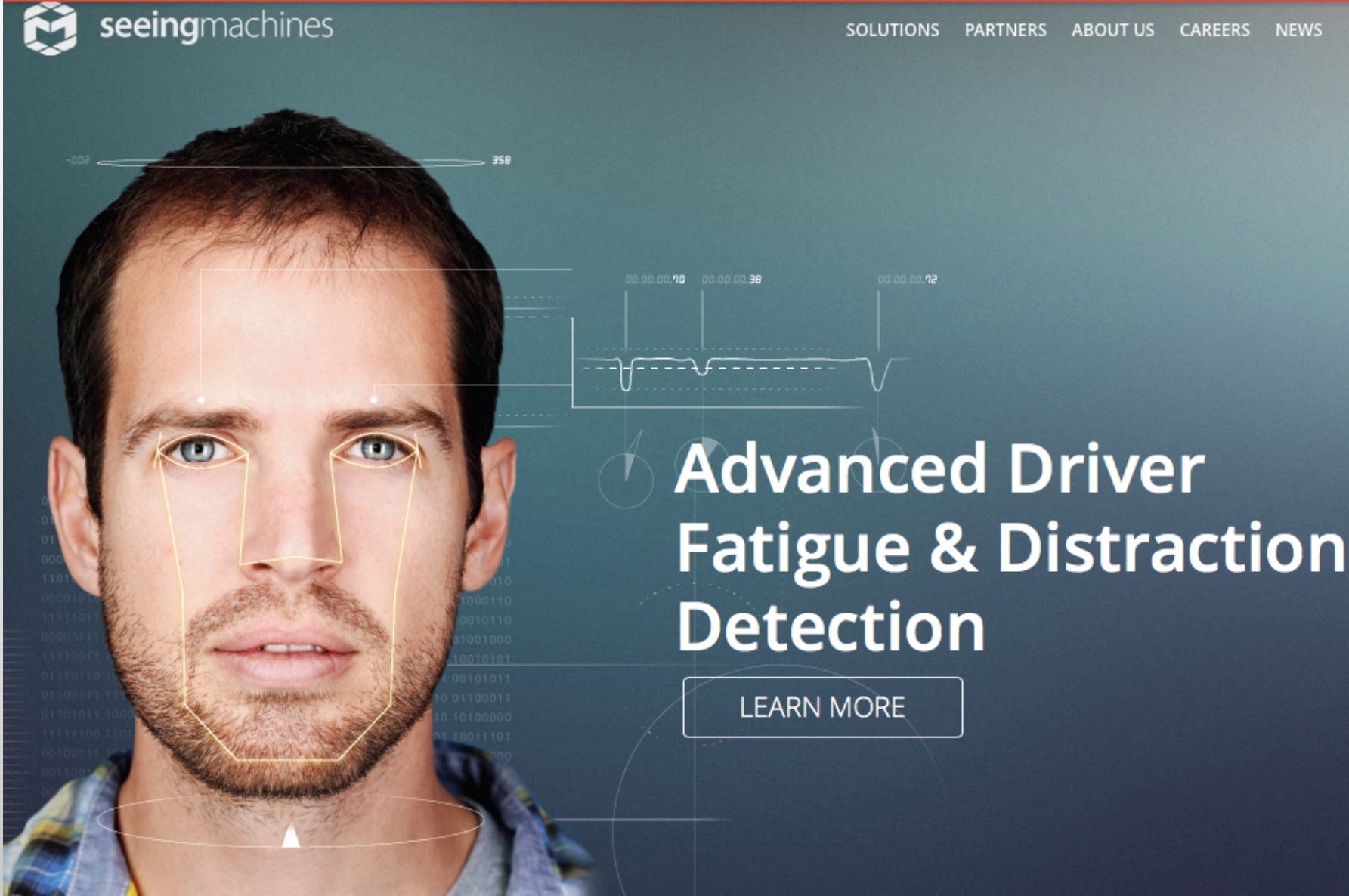


Opportunities and Incentives for Rest

Driving culture and the physical infrastructure



Detecting Drowsiness: Eye gaze, head pose, eye closure



The image is a screenshot of the Seeing Machines website. At the top left is the company logo, a stylized 'M' inside a cube, followed by the text 'seeingmachines'. To the right of the logo is a navigation menu with the following items: 'SOLUTIONS', 'PARTNERS', 'ABOUT US', 'CAREERS', and 'NEWS'. The main visual is a close-up of a man's face. Overlaid on the face are several white and yellow lines representing facial tracking and analysis. A horizontal line with arrows at both ends is positioned above the forehead, with the number '358' on the right and '-002' on the left. A yellow outline traces the man's eyes, nose, and mouth. To the right of the face, there is a white line graph representing a bio-signal, with three vertical markers and time labels: '00.00.00.70', '00.00.00.38', and '00.00.00.72'. The background of the website is a dark teal color with faint binary code (0s and 1s) scattered across it. In the bottom right corner, there is a large white text overlay that reads 'Advanced Driver Fatigue & Distraction Detection'. Below this text is a white rectangular button with the text 'LEARN MORE' inside it.

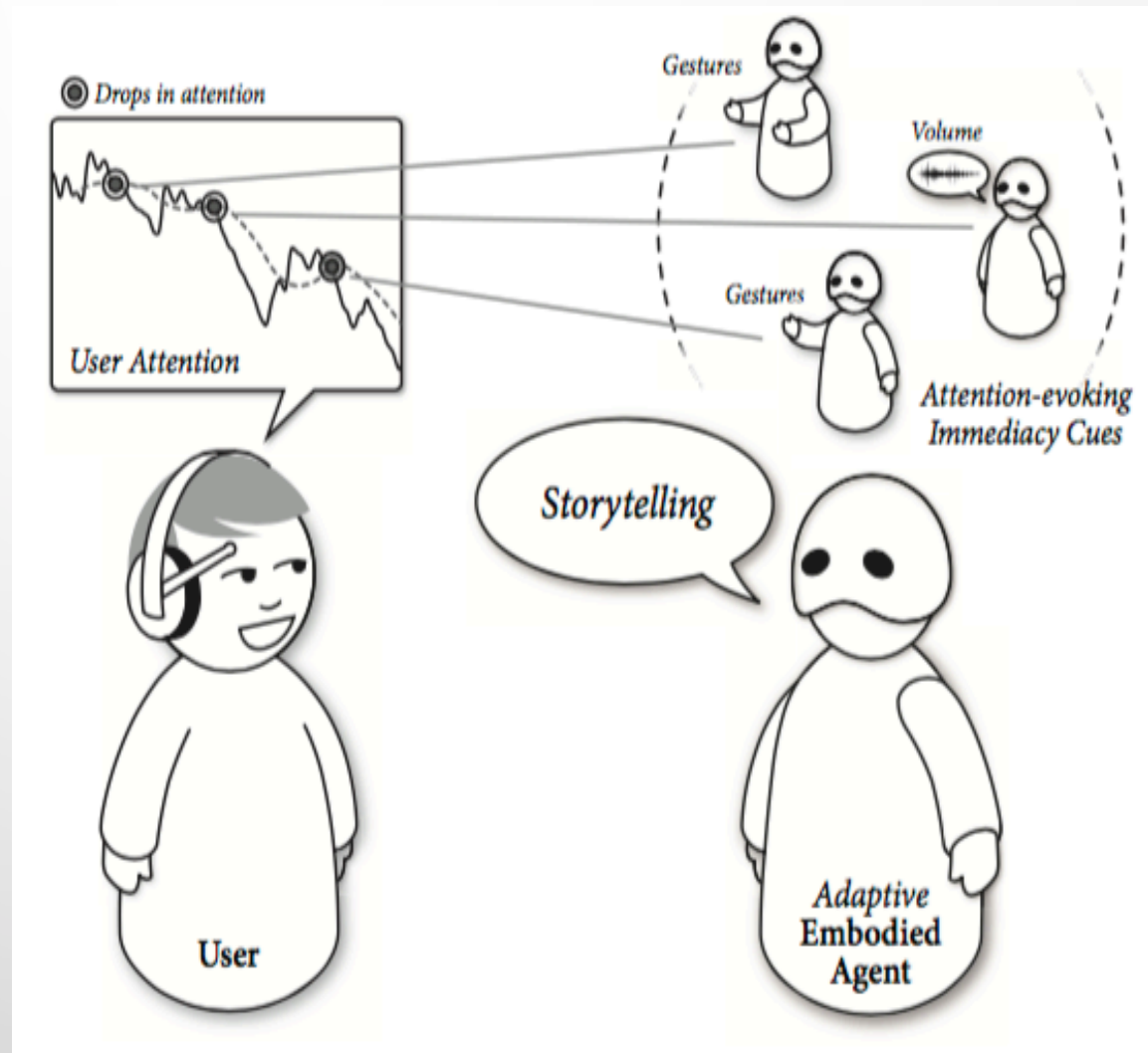
seeingmachines

SOLUTIONS PARTNERS ABOUT US CAREERS NEWS

Advanced Driver Fatigue & Distraction Detection

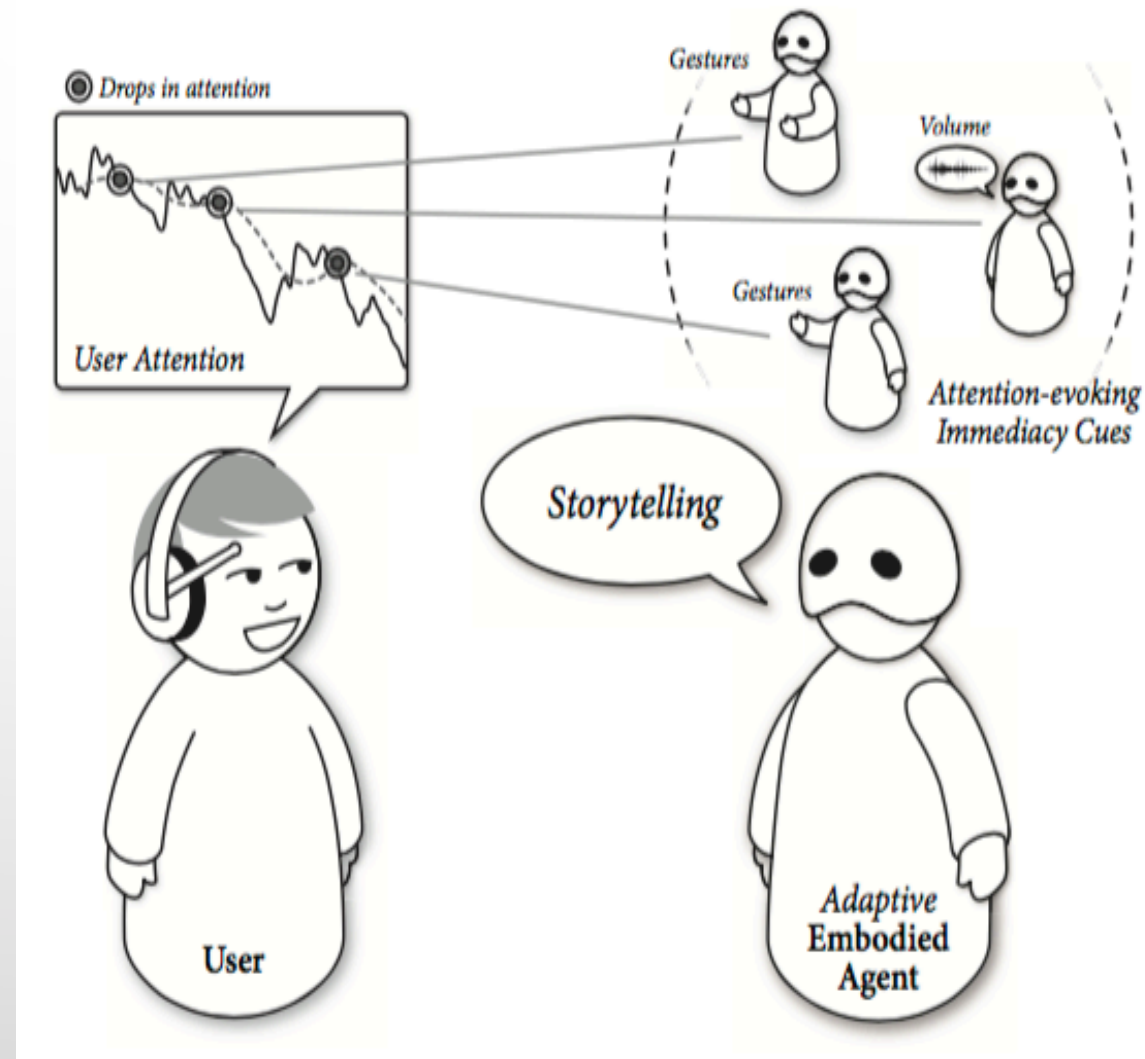
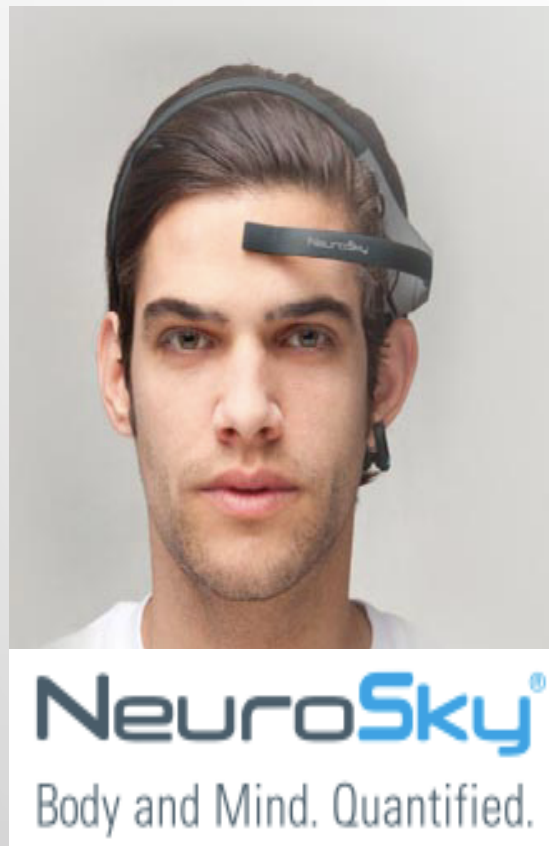
LEARN MORE

EEG estimates of brain state



Szafir, D., & Mutlu, B. (2012). Pay attention!: Designing adaptive agents that monitor and improve user engagement. *CHI* 1–10.

EEG estimates of brain state



Szafir, D., & Mutlu, B. (2012). Pay attention!: Designing adaptive agents that monitor and improve user engagement. *CHI* 1–10.

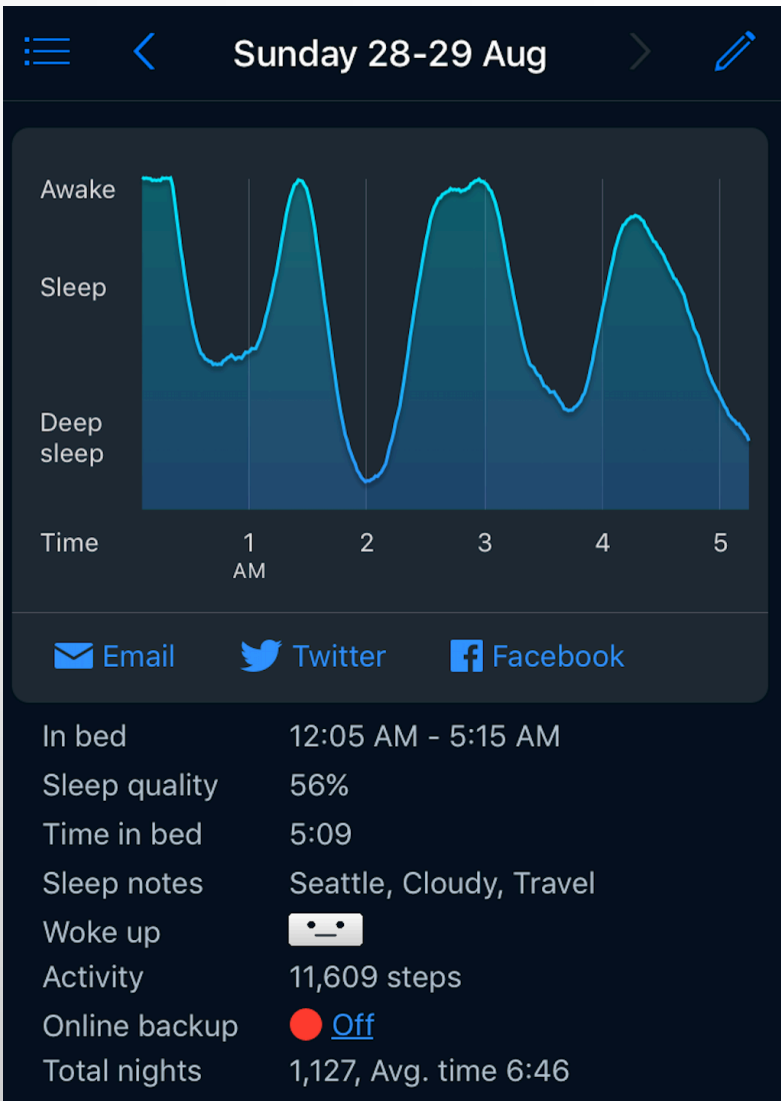
Warning and Automatic Emergency Steering & Braking



Warnings: Too little to late?



Smart Environment to Avoid Starting a Risky Trip



<http://www.aadaetreview.com/reviews/smart-home-automation-reviews>



Vehicle Control: Making driving “easy” can make it hard



Self-driving(?) Vehicles



<http://www.news965.com/news/news/local/tesla-driver-caught-camera-sleeping-traffic/nrTX2/>

Use “Self-Driving” Vehicles of Today



Drowsy Driving and Technology:

Crash contributions, causes, and countermeasures

- Get better sleep
- Avoid dangerous times of day, take breaks
- Manage work and life pressures

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