Driving Attention:
Cognitive Engineering in Designing Attractions and Distractions

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Main Themes

- Technological change **redefines the human role**, often with profound and unexpected consequences
- **Technology mediates attention**—positively and negatively
- Great potential to draw meaning from large and complicated **streams of data for feedback and adaptation**

Technology can undermine attention

IMPORTANT Using G-Meter Lite on public roads may be dangerous. Spirited driving should be reserved for safe locations.

$0.99 BUY APP

- acceleration/braking G graph
- mounting position calibration – tilt and swivel your iPhone any way you like!

IMPORTANT Using G-Meter Lite on public roads may be dangerous. Spirited driving should be reserved for safe locations.

LANGUAGES:
English

REQUIREMENTS:
Compatible with iPhone and iPod touch
Requires iPhone 2.0 Software Update

Silverview Consulting Inc. Web Site
G-Meter Lite Support

ALL APPLICATIONS BY SILVERVIEW CONSULTI...
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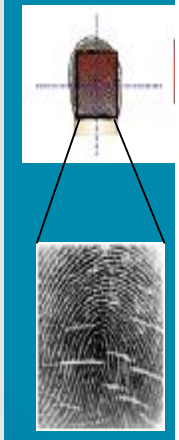
APP STORE FAQS

CUSTOMERS ALSO BOUGHT See All

G-FORCE
Sports

gMeter
Sports

Technology augments drivers and automates the vehicle



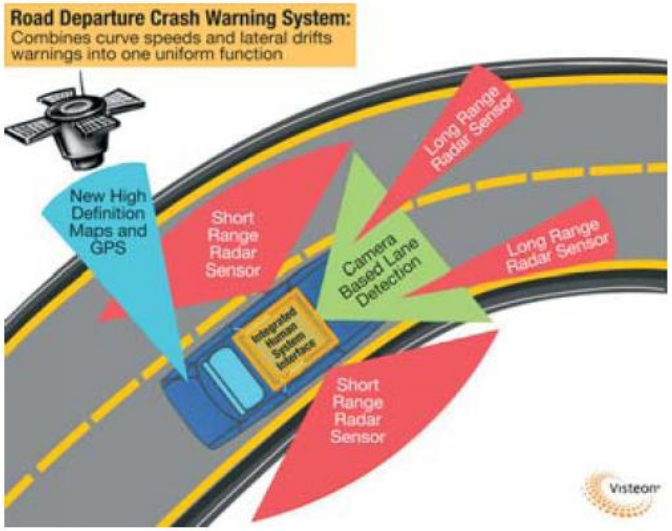


Figure 2. Roadway departure warning system and sensors. (Figure courtesy of Visteon, 2006.)

Adaptive technology enhances feedback and individualizes the vehicle

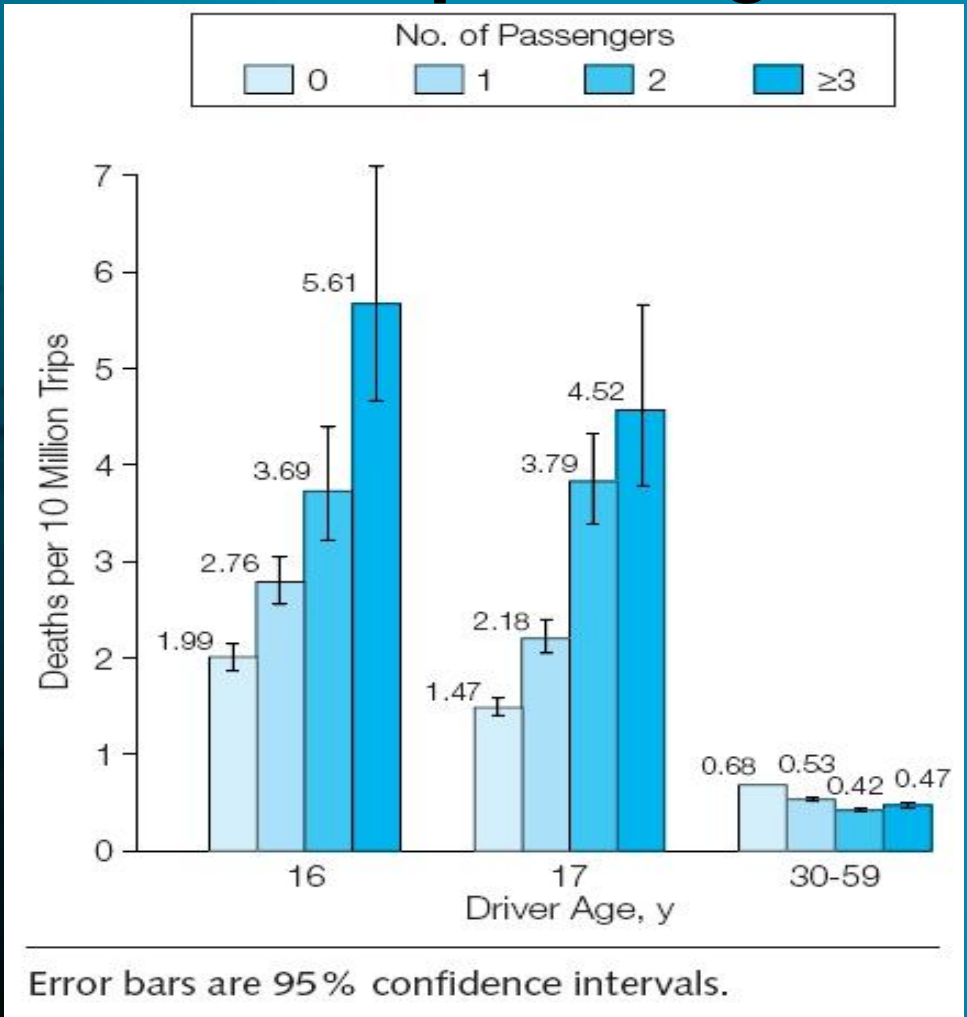
Technology and vulnerable drivers

Good drivers?

Evans (2004)

Passengers and crash risk

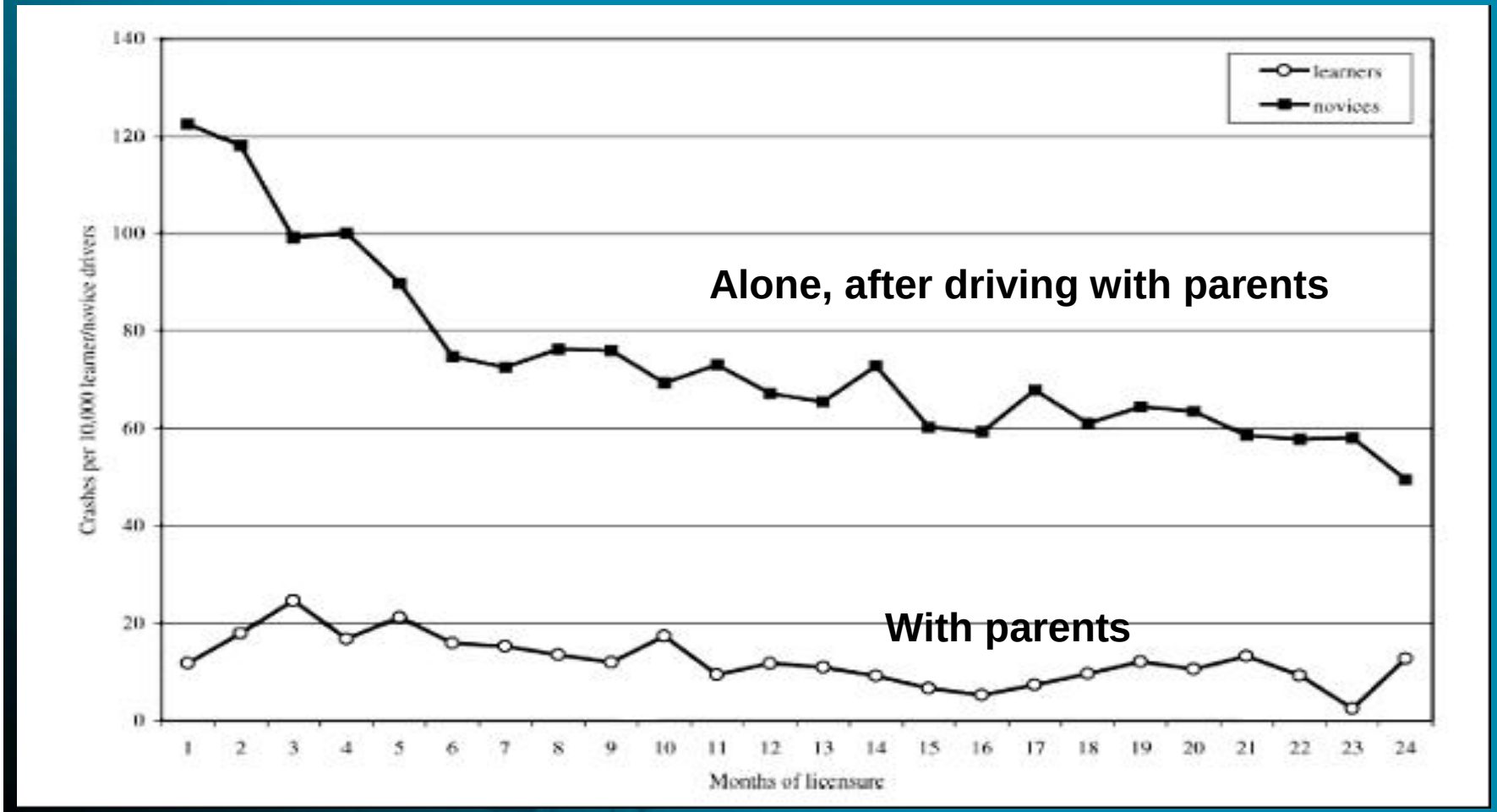
Avoid “teen passenger” effect



Chen, L., Baker, S. P., Braver, E. R., & Li, G. (2000)

Passengers and crash risk

Technology to promote “parent” effect

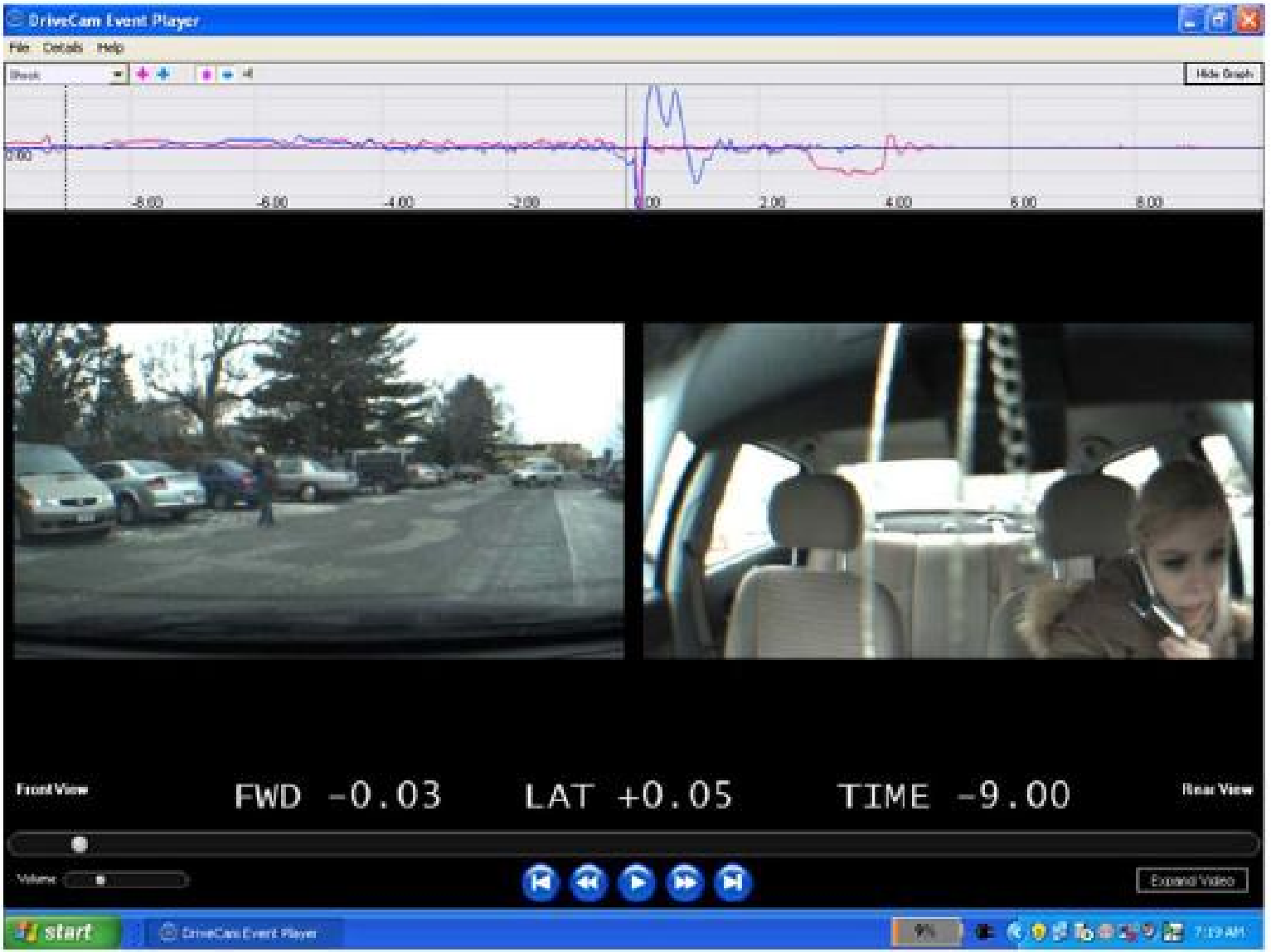


(Mayhew et al., 2003)

Technology distraction

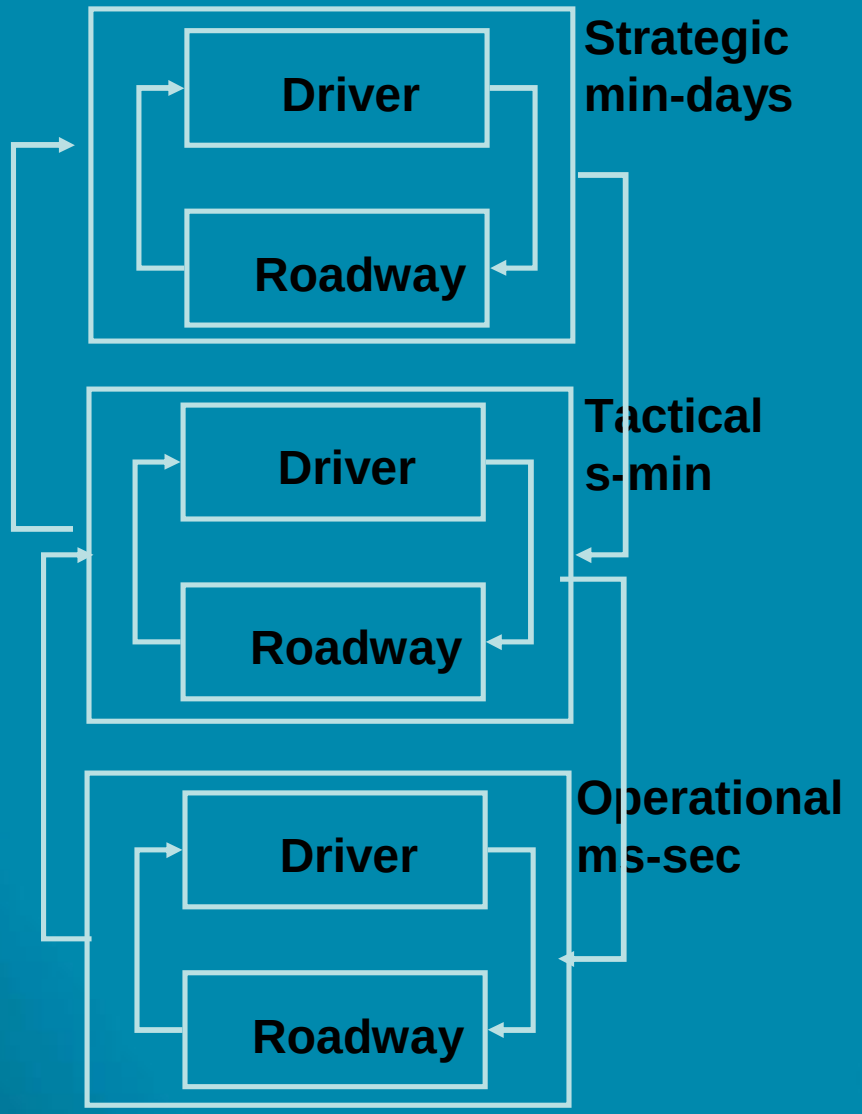
- Technology brings teen “passengers” into the car…or train

Event triggered video



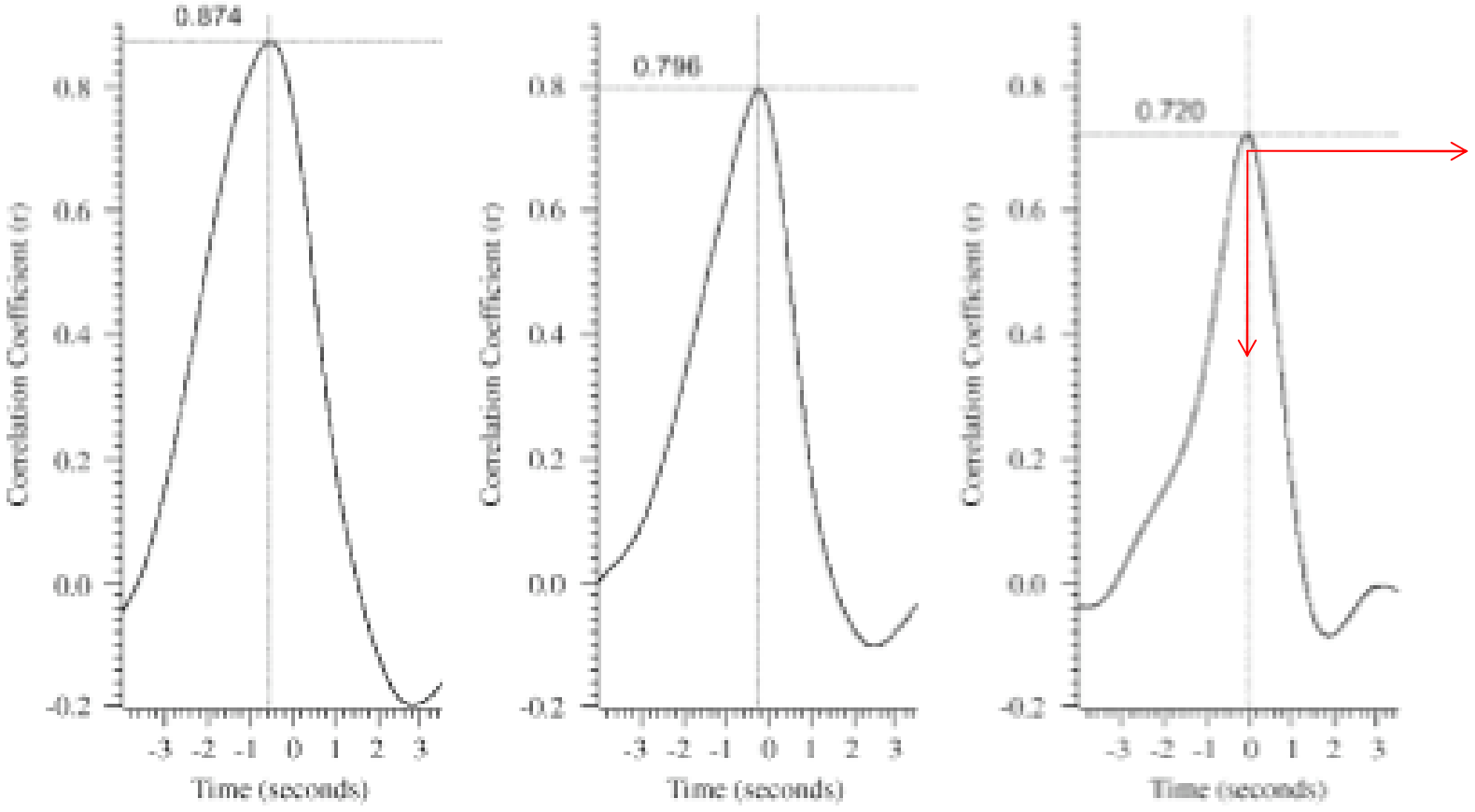
Multi-level Control with Imperfect Feedback

- Dynamical system of feedforward, feedback, adaptive control
- Poor feedback at all levels



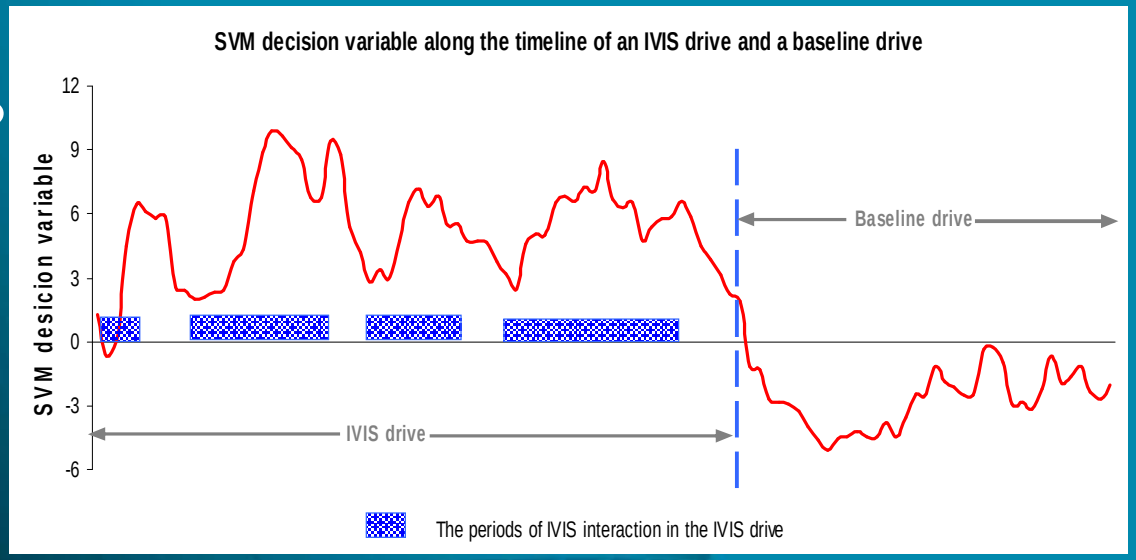
Detecting impairment for feedback and adaptation

- Cross-correlogram—steering and eyes



Marple-Horvat etl al (2008) 40ml Vodka 100ml Vodka

Detecting distraction for feedback and adaptation

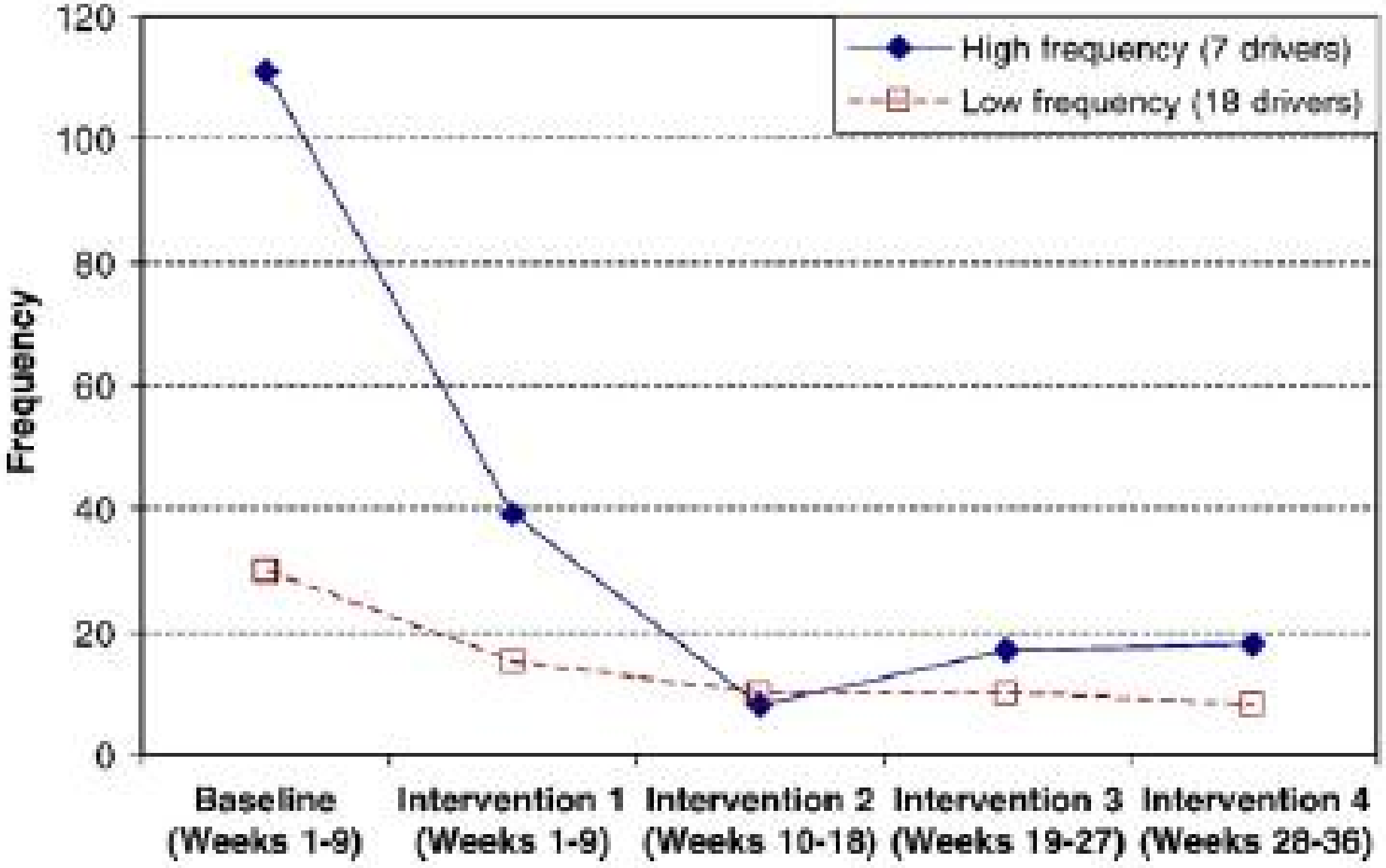


Predicting distraction

Predicting distraction

Provide feedback regarding distraction—
Bring “parent” into car

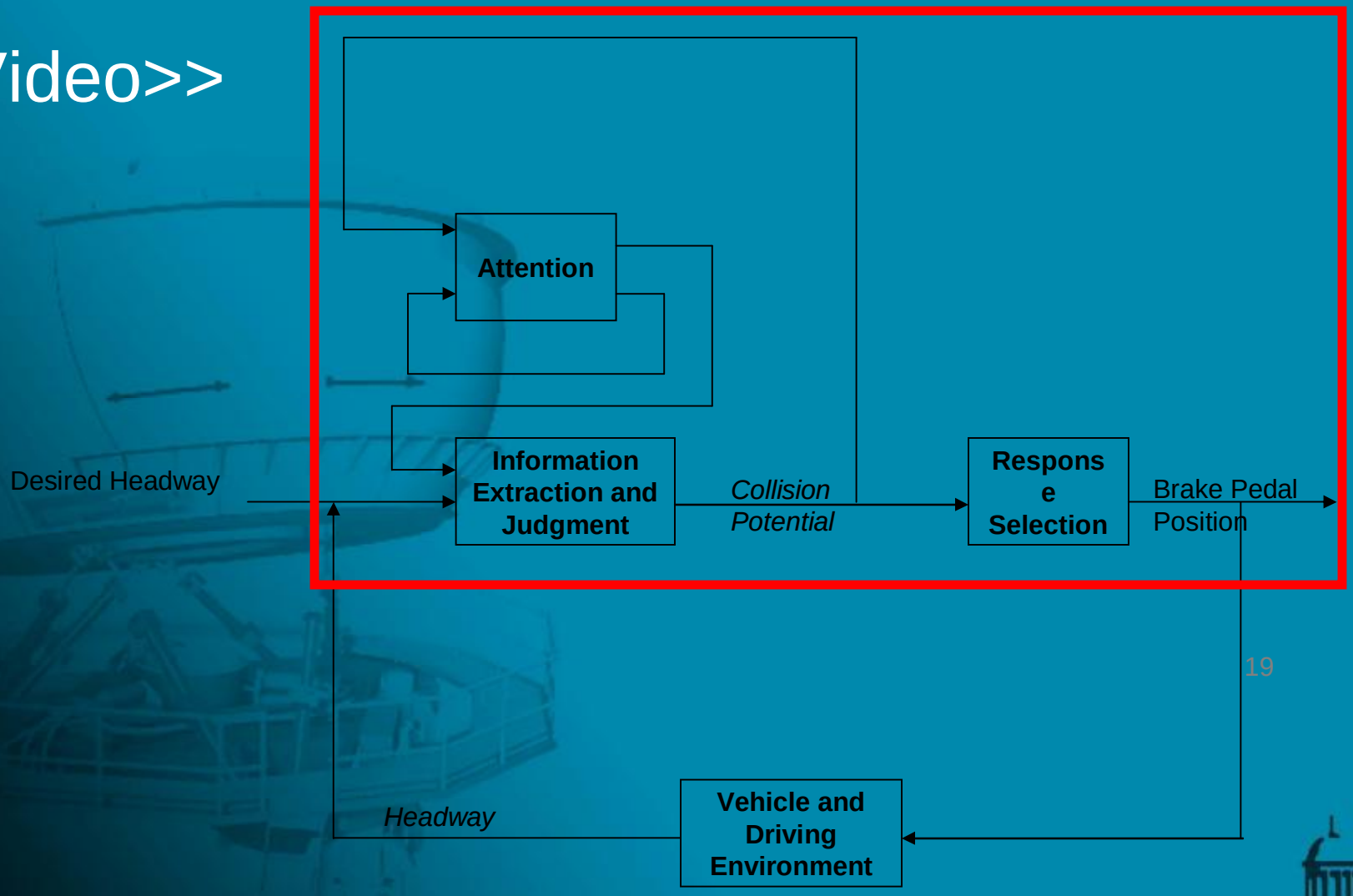
http://www.familypoet.com/graphics/Student-Driver.gif



McGehee, D. V., Raby, M., Carney, C. H., Reyes, M. L., & Lee, J. D. (2007). Extending parental mentoring using an event-triggered video intervention in rural teen drivers. *Journal of Safety Research, 38*, 15-227.

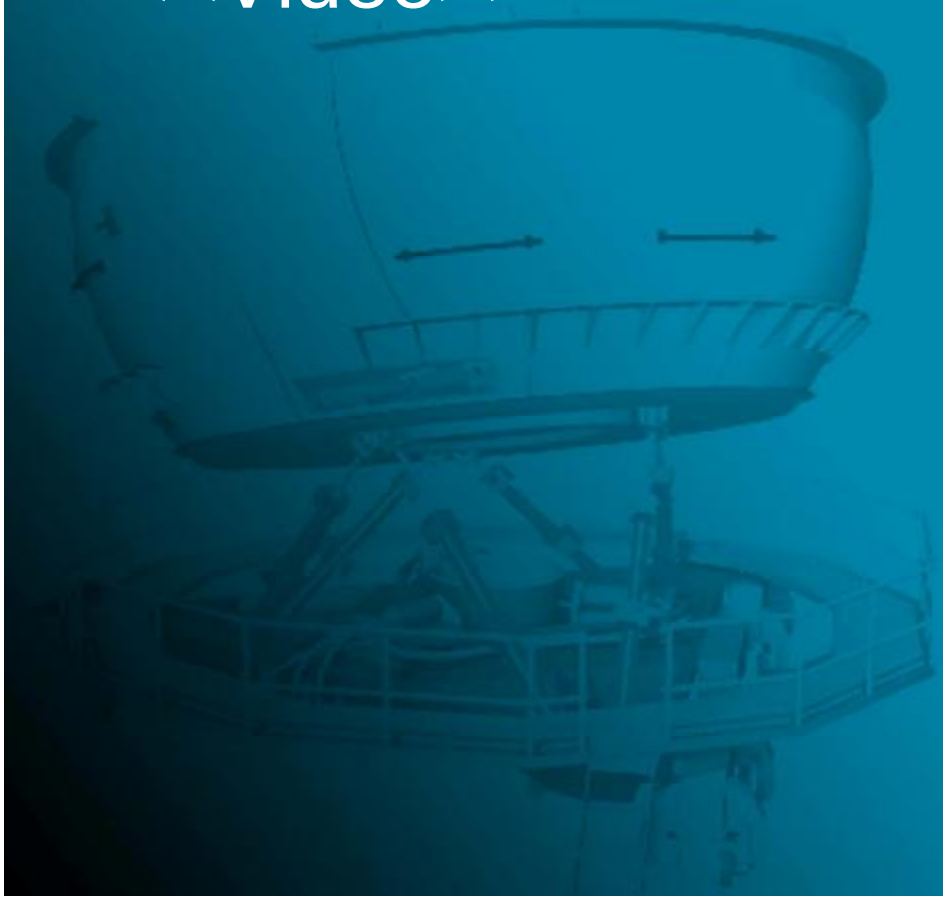
Collision warnings enhance attention to the road

<<Video>>



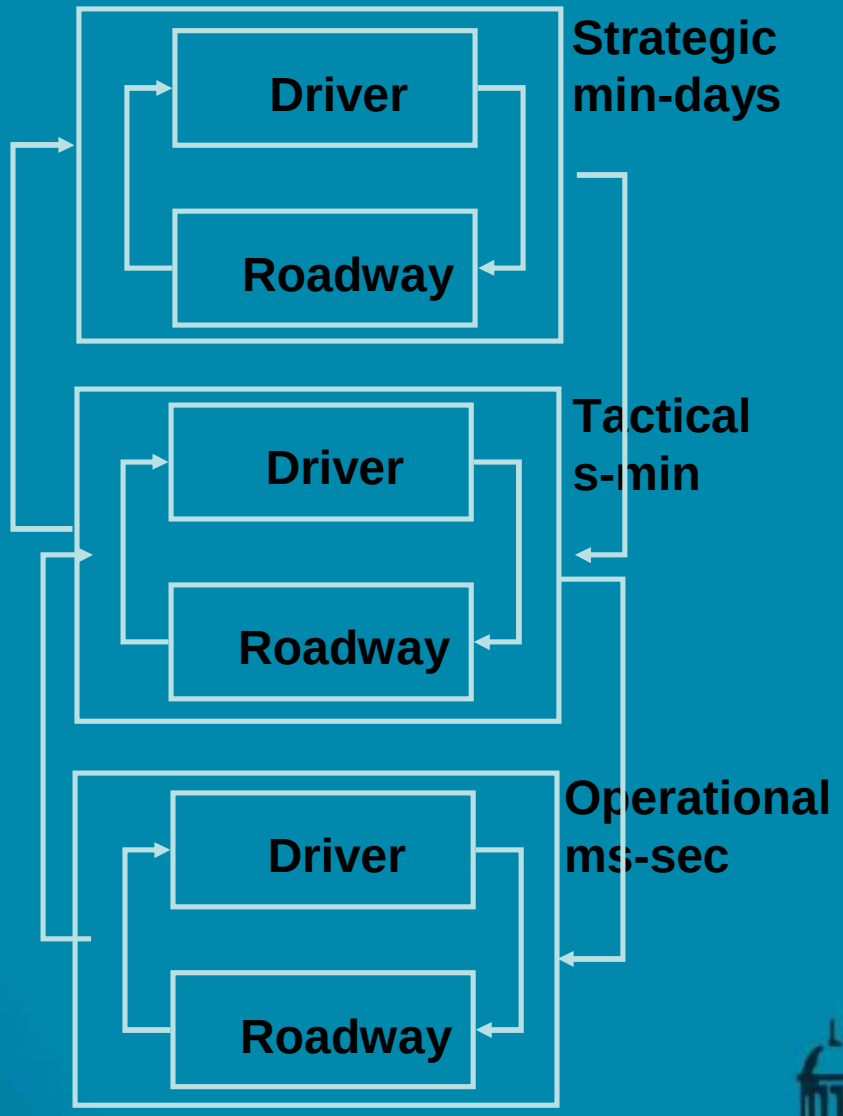
Robust responses to extreme events?

<<Video>>



Three levels of adaptation

- Behavioral adaptation
- Response to “false alarms”
- Volvo control engineers worrying about drivers’ “trust” in warnings?



Conclusions

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References

- Brown, T. L., Lee, J. D., & McGehee, D. V. (2001). Human performance models and rear-end collision avoidance algorithms. *Human Factors, 43(3), 462-482.*
- Chen, L., Baker, S. P., Braver, E. R., & Li, G. (2000). Carrying passengers as a risk factor for crashes fatal to 16- and 17-year old drivers. *Journal of the American Medical Association, 283(12), 1578-1582.*
- Donmez, B., Boyle, L. N., & Lee, J. D. (2008). Mitigating driver distraction with retrospective and concurrent feedback. *Accident Analysis and Prevention, 40(2), 776-786.*
- Evans, L. (2004). *Traffic Safety. Bloomfield Hills, Michigan: Science Serving Society.*
- Lee, J. D. (2008). Fifty years of driving safety research. *Human Factors, 50(3), 521-528.*
- Lee, J. D. (2007). Technology and the teen driver. *Journal of Safety Research, 38(2), 203-213.*
- Lee, J. D. (2006). Driving safety. In R. S. Nickerson (Ed.), *Review of Human Factors (pp. 172-218). Santa Monica, CA: Human Factors and Ergonomics Society.*
- Liang, Y., Reyes, M. L., & Lee, J. D. (2007). Real-time detection of driver cognitive distraction using Support Vector Machines. *IEEE Intelligent Transportation Systems, 8(2), 340-350.*
- Mayhew, D. R., Simpson, H. M., & Pak, A. (2003). Changes in collision rates among novice drivers during the first months of driving. *Accident Analysis & Prevention, 35, 683-691.*
- Marple-Horvat, D. E., Cooper, H. L., Gilbey, S. L., Watson, J. C., Mehta, N., Kaur-Mann, D., et al. (2008). Alcohol badly affects eye movements linked to steering, providing for automatic in-car detection of drink driving. *Neuropsychopharmacology, 33, 849 – 858.*
- McGehee, D. V., Raby, M., Carney, C. H., Reyes, M. L., & Lee, J. D. (2007). Extending parental mentoring using an event-triggered video intervention in rural teen drivers. *Journal of Safety Research, 38, 215-227.*