



 **MITSUBISHI ELECTRIC RESEARCH LABORATORIES**
Cambridge, Massachusetts

Voice Search While Driving Is it Safe??

Kent Wittenburg, VP & Director

Mitsubishi Electric Research Laboratories
Cambridge, MA USA

Voice Search 2009
San Diego, California

Innovative mobile applications



Courtesy of Bruce McCall

Innovative mobile applications for the car

- Now 275 car models have iPod connectors
5 years ago: 0 models*
- Models with DVD entertainment systems have doubled in 5 years*
- Nav systems, customizable environment settings, Bluetooth, satellite radio, messaging, web access,...
- Over \$12B will be spent on electronic enhancements for vehicles in 2008**

But, by the way, is this safe?

**NY Times* Cars Special Section, October 30, 2008

**CEA Industry Forecast, November, 2008

Eye movements operating an iPod while driving



Video courtesy of Donald Fisher, HPL, U. Mass. Amherst

Speech interfaces to the rescue! Eyes free (mostly)! Hands free (mostly)!



- Command & control
- Music selection
- News & information control
- Voice call setup
- Destination entry
- Point of interest finding
- Dictation and voice output for email and text messaging
- ...

But, are voice interfaces
really safe?
Are they all the same?

Areas of Concern

- **Stateful language dialogs**
 - Only a subset of commands available
 - Does the user know what to say?
 - What if the system fails to understand?
 - What if the system state doesn't correlate with the user's intentions?
- **System-paced dialogs**
 - The system prompts the user, waiting for a response
 - What if the user needs to attend to driving?
 - An additional distraction from the road?



Dialog-based Music Finding



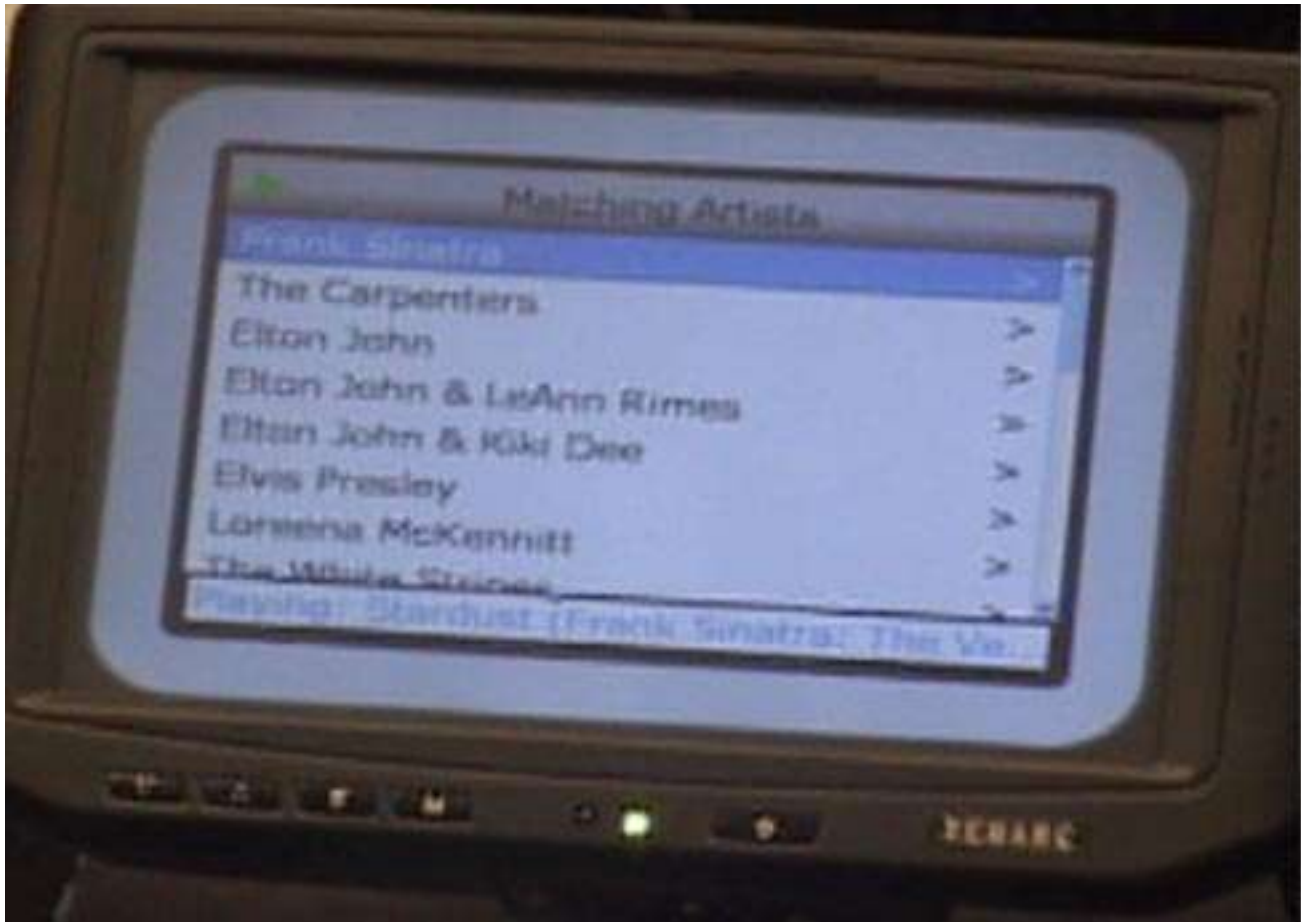
Commercially available system

Voice search (Speech-in List-out) alternative

- Stateless language dialogs
 - All commands always available
 - User may say anything
 - Only failure is unsatisfactory result—try again
- User-paced
 - The system never prompts the user
- Speech used only when needed
 - Haptic input for list navigation, state selection, etc.



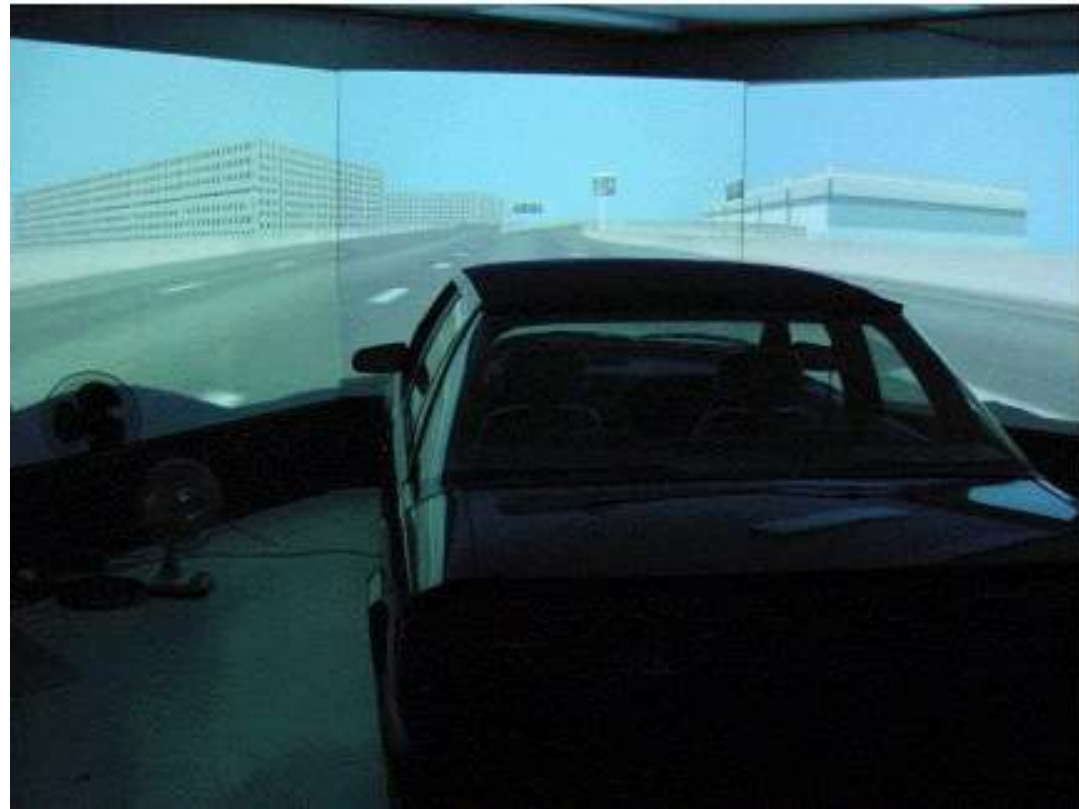
Voice Search Music Finding



MERL's SpeakPod prototype

Testing the hypothesis

- Collaboration with U. Massachusetts Human Performance Laboratory (D. Fisher, Director)
 - Driving simulator
 - Eye tracker



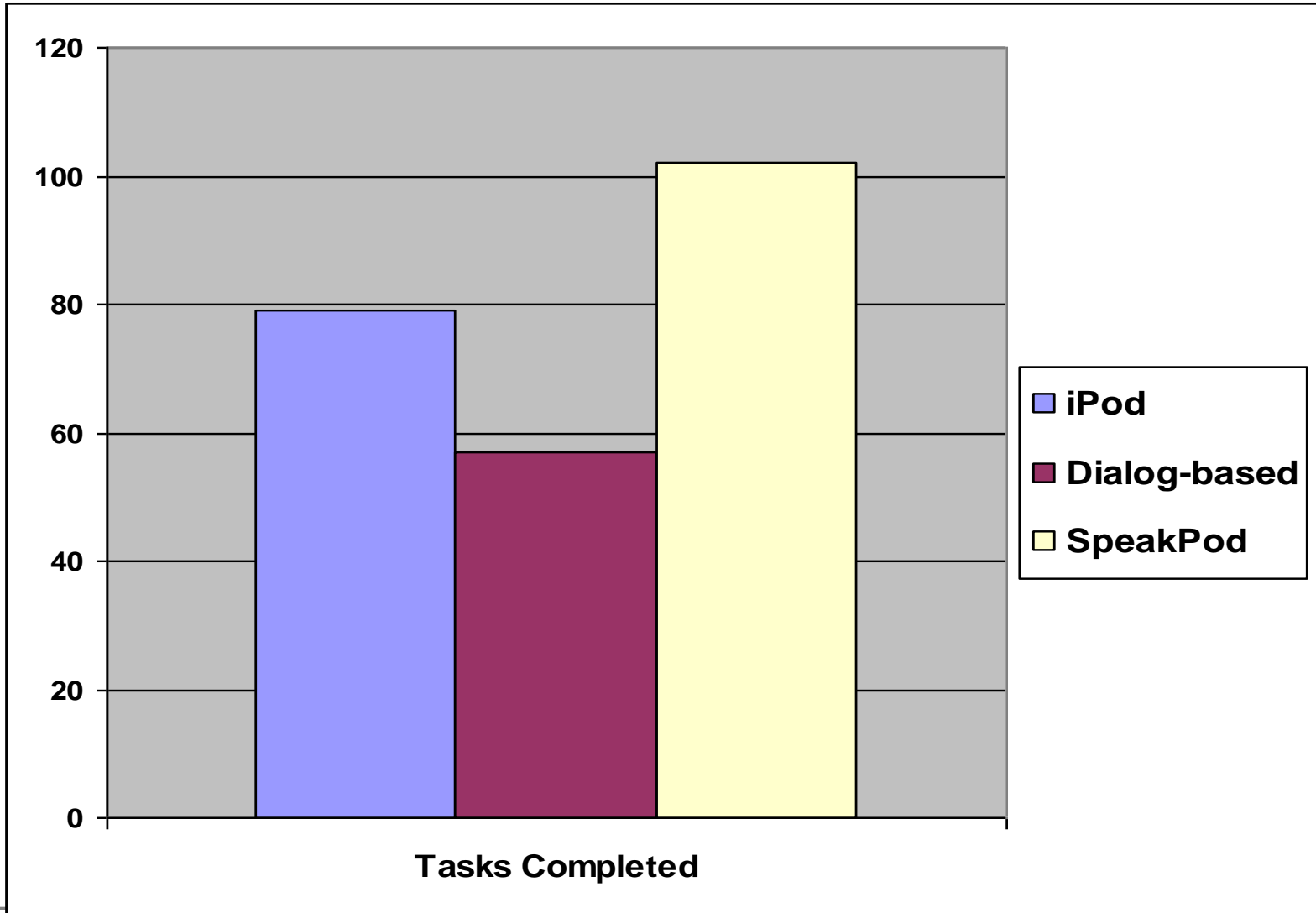
Three conditions for finding music while driving

	Display	Haptic Interface	Secondary Input Modality
A. iPod	2.5-inch LCD	click-wheel	none
B. Commercial aftermarket in-dash unit	7-inch LCD	wheel-mounted remote	speech (dialog-based)
C. MERL SpeakPod prototype	7-inch LCD	wheel-mounted remote	speech (query-based)

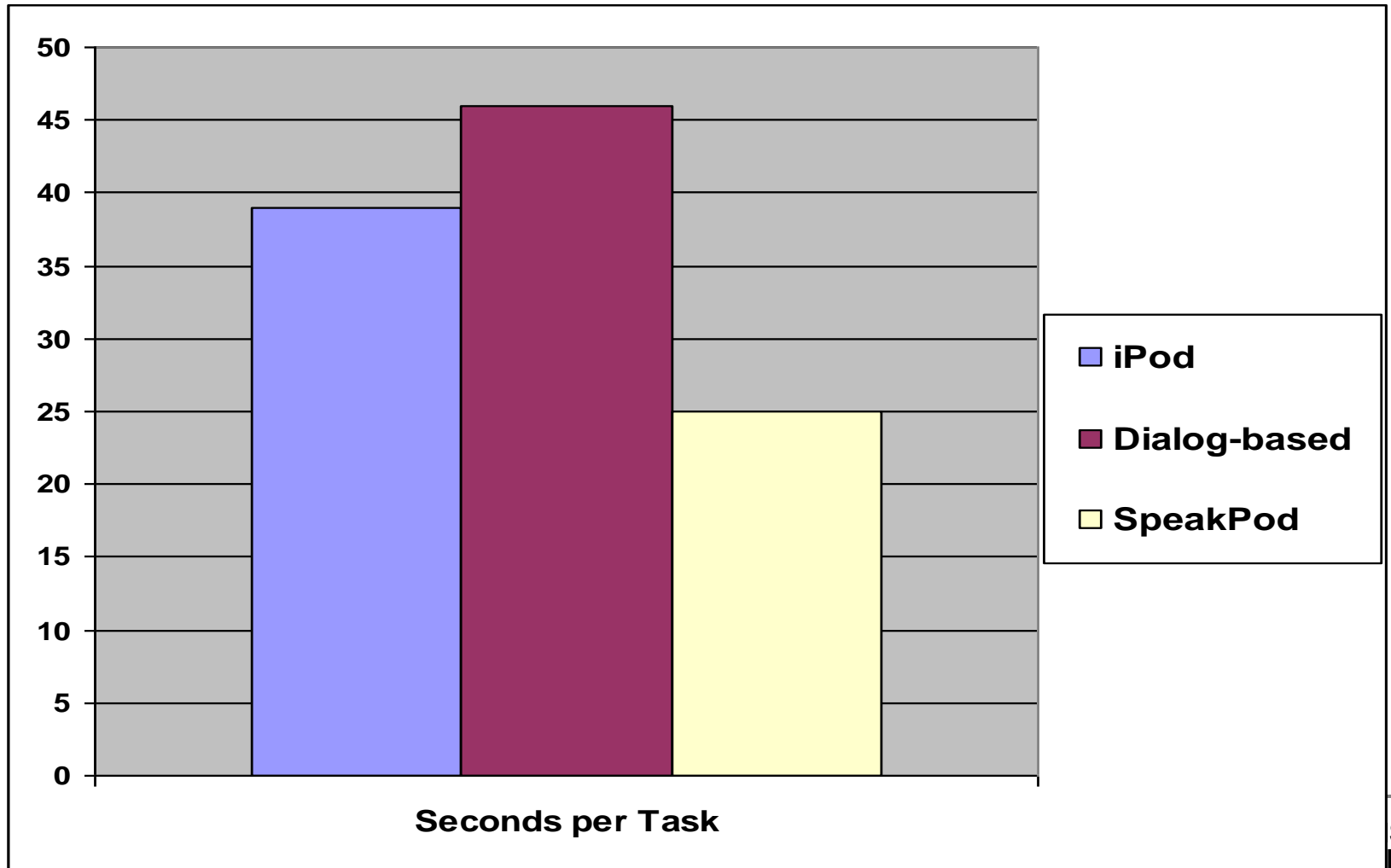
Experimental procedure

- 17 native English speakers (12 men, 5 women) from students and staff of U. Mass.
 - Ages 18 to 30 (average 21.5)
 - iPod experience
- Music retrieval task (finding a specified item)
 - Specified song
 - Any song from specified album
 - Any song from specified artist
- Simulated driving task (4 different blocks per user)
 - Eye movements monitored
 - Music retrieval tasks timed and marked successful or not

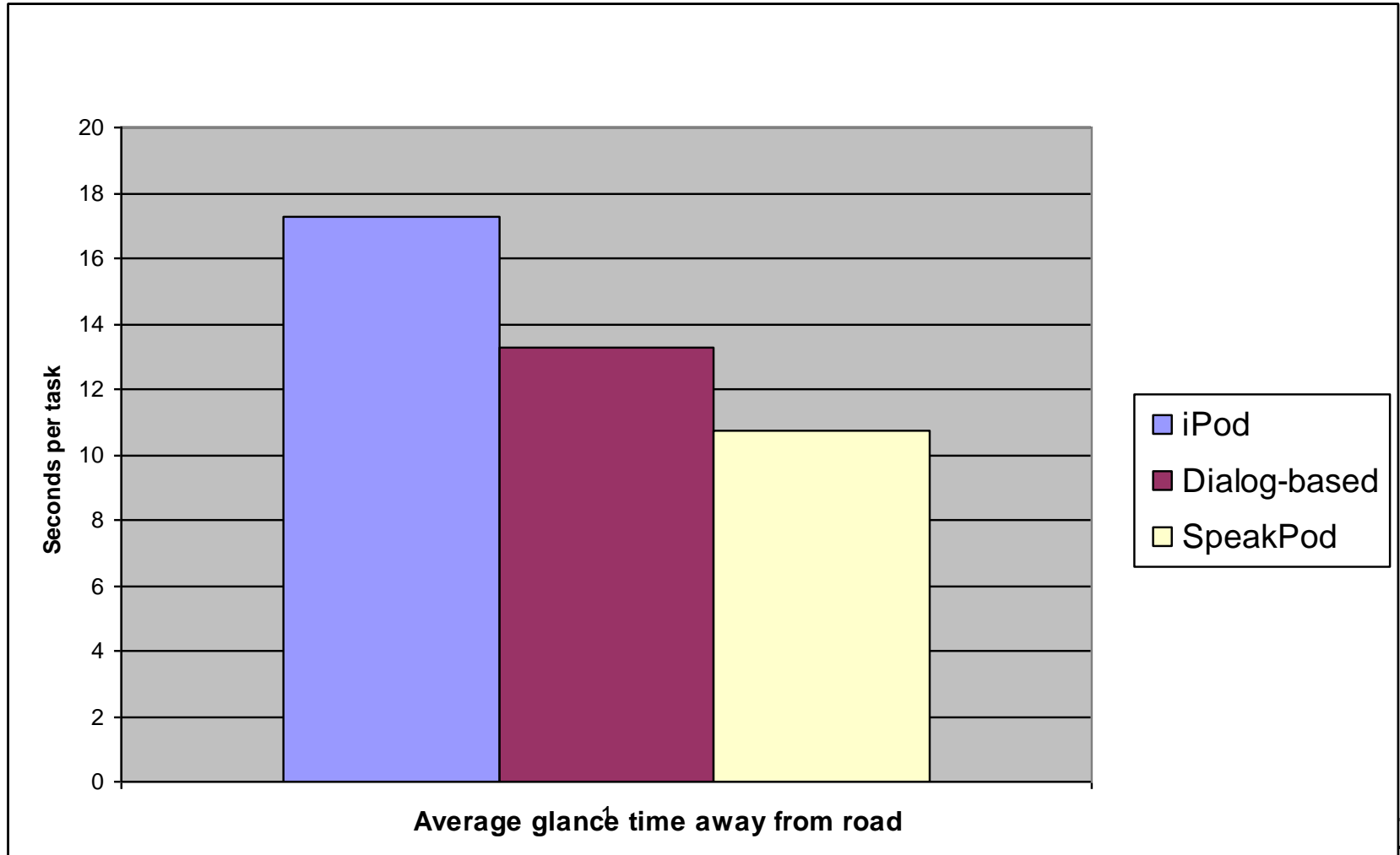
Task success rate



Task time completion

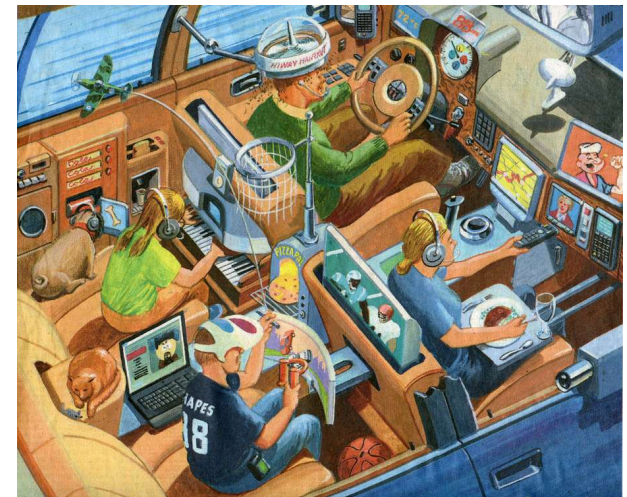


Average glance time away from the road



Conclusions

- Myriad of new features and gadgets compete for driver's attention
- Ultimate user experience must include safety!
- Speech interfaces are a good direction
- However, different UI dialog models may influence safe driving
 - Stateful dialogs, system pacing
 - Stateless dialogs, user pacing
- Initial experiment
 - Some support for hypothesis
 - Need for further testing and research



Acknowledgements

- Contributors to SpokenQuery
 - Evandro Gouvea, Bret Harsham, Bhiksha Raj, Bent Schmidt-Nielsen, Hugh Secker-Walker, Garrett Weinberg, Joe Woelfel, Peter Wolf
- Contributors to driving simulation studies
 - U. Mass.: Lisandra Garay-Vega, Anuj Pradhan, Yan Shen, Gautam Divekar, Marrhew Romoser, Michael Knodler, Donald Fisher
 - MERL: Garrett Weinberg, Bent Schmidt-Nielsen, Bret Harsham, Cliff Forlines

Further Information

- <http://www.merl.com/projects/SpokenQuery>