

**Driver Workload Effects of Cell Phone,
Music Player, and Text Messaging
Tasks with the Ford SYNC Voice
Interface Versus Hand-held Visual-
Manual Interfaces**

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Background

■ Cell phone subscriptions continue to grow

- ⌘ 960% growth since 1995 (www.ctia.org):
 - From 28.1 million in 1995 to 270.6 million as of January 12th, 2009

■ Driving and cell phone use is commonplace

- ⌘ Nationwide Ins. "Life-On-The-Go" Survey (2007): 73% of respondents report talking on cell phone while driving
- ⌘ AAA Foundation survey "Cell Phones and Driving: Research Update" (2008): 53% to 61% reported talking on a cell phone within the past month

■ Percentage of drivers who are on a cell phone is increasing

- ⌘ 10% of drivers on cell phones at any given moment (Glassbrenner, 2005)

■ 2006 GMAC Insurance study polled 5,288 licensed drivers and found 20% of drivers between the ages of 18 to 24 had selected songs on an iPod while driving.

■ Clearly, the public has embraced these technologies



NHTSA - Sponsored VTTI 100-Car Study: Visual Distraction is the Main Problem (Not Cognitive Distraction)

- **Visual Manual Tasks Raise Risk: Talking / Listening on Cell Phones do not**
 - ⌘ "Dialing handheld device" had statistically significant risk ratio of 2.79 (Klauer, et al., 2006)
 - ⌘ "Talking/Listening to handheld device" risk ratio of 1.3 is not statistically significant different from Just Driving (Klauer, et al., 2006)
 - ⌘ Looking away from the road scene for greater than 2.0 seconds was associated with Risk Ratio of 2.27 (Klauer, et al., 2006)
- **Looking Away from the Road Scene is the Principal Contributor to Crashes and Near Misses**
 - ⌘ *"An important finding of this report is that almost 80 percent of all crashes and 65 percent of all near crashes involved the driver looking away from the forward roadway just prior to the onset of the conflict."* (Dingus, et al., 2006)
 - ⌘ *"The important finding in this regard is that 93 percent of all lead-vehicle crashes (14 out of 15) involved inattention to the forward roadway as a contributing factor."* (Dingus, et al., 2006)
 - ⌘ *"In fact, the data from the "100 Car" study (1) shows that it is a rare case that a crash occurs while the driver's eyes are on the forward roadway, regardless of any other "cognitive demand" that they might be engaged in."* (Dingus and Klauer, 2008).

UMTRI Field Operational Test: Naturalistic Driver Distraction Assessment

■ Cell phone effects benign:

- ⌘ Highest steering angle variance but no lanekeeping effects
- ⌘ No change in speed variance
- ⌘ Braking smoother when it occurred while using the cell phone.
- ⌘ Fewer & shorter glances away from road than 'just driving'
 - Eating and conversations (with passengers) resulted in more and longer glances away.

■ UMTRI Researchers Underscore the Need for Naturalistic Studies

- ⌘ *"These findings highlight the importance of conducting naturalistic studies, as it appears that controlled studies cannot always account for the full effects of driver choice and perceived risk associated with immersion in actual traffic/roadway environments."* (Sayers, et al., 2007, p. 230)



“Hands Free is no better than Hand Held”: FALSE

Study	Venue	Task Duration	2nd Task Errors	Lane keeping	Speed	Car Following	Eye Glances	Object & Event	Subjective Assessments
Serafin, Wen, Paelke, & Green (1993)	Simulator	V		V					V
Tijerina, Parmer, and Goodman (1998)	Track	Nav. V or N		V			V		
Graham & Carter (2001)	Simulator			V					
Gartner, Konig, and Wittig (2001)	Road	M	M	V	V				V
Ishida and Matsuura (2001)	Track			V			V	V	
Salvucci and Macuga (2001)	Simulator	M		V	V				
Jenness, Lattanzio, O'Toole, Taylor, & Pax (2002)	Simulator			V			V		
Ranney, Harbluk, Smith, Huener, Parmer, and Barickman (2003)	Track	M		V		V		V	N
Greenberg, Tijerina, Curry, Artz, Cathey, Kochhar, Kozak, Blommer, & Grant (2003)	Simulator			V		N		V	
Itoh, Miki, Yoshitsugu, Kubo, and Mashimo (2004)	Simulator	V		V		N	V		V
Tsimhoni, Smith, and Green (2004)	Simulator	V	V	V	V	V	V		V
Chiang, Brooks, and Wier (2005)	Road	M	M (ph) V (other)	V			V		V (small)
Angell, et. al. (2006a, 2006b)	Road & Track	M		N	N		V	V	V
Medenicka and Kun (2007)	Simulator			V	V				V
Schreiner, Blanco, and Hankey (2004a)	Track	M		N	N		V		
Schreiner, Blanco, and Hankey (2004b)	Road	M					V	V	
Schreiner (2006)	Simulator	M	M or N	V	M				V
Ranney, Watson, Mazzae, Papelis, Ahmad, & Wightman (2005)	Simulator	M (dial) V (answer)	M	V		N		N	V



Notes: V = Voice interface resulted in better performance than Manual interface
M = Manual interface resulted in better performance than Voice interface
N = No difference
Blank = not addressed in the report



Introduction to Ford's Study

- **OBSERVATION**: People are using devices in vehicles that are not designed for use while driving
- **SOLUTION**: SYNC™ provides a hands-free voice interface to use cell phones and personal music players.
- **STUDY PURPOSE**: to compare driving performance in a fixed base driving simulator using SYNC's voice interface to hand-held cell phones and music players.

Methodology: Participants

- N = 25 volunteer Ford employees
 - ≡ No SYNC developers/testers/etc
- Self-described as “regular SYNC users” who own a personal music device (e.g., iPod) and a cell phone
 - ≡ While they were “regular users,” they were generally only proficient in a subset of tasks and SYNC functionality

	16-35	36-44	45+	
	years	years	years	Total
Male	9	1	10	20
Female	1	1	3	5
Total	10	2	13	25

Methodology: Procedure

- Basic proficiency was established for all SYNC tasks
- Data collection began after a familiarization drive
 - ≡ “Just Drive” task (60 s) for baseline driving
- Participants performed tasks while following a lead vehicle traveling at a constant speed of 60 mph
- Participants were required to respond to a Pedestrian Detection Task (PDT) as a measure of situational awareness during each task
 - ≡ Pedestrian walking on right shoulder of simulator roadway appeared suddenly during the task
 - ≡ Test participant flashed high beams (‘flash to pass’) to indicate awareness

Measures

- Measurement Categories and Measures
 - ≡ Task Completion Time
 - Total Task Time
 - ≡ Eye Glance Behavior
 - Total Eyes Off Road Time
 - ≡ Lateral Control
 - Standard Deviation of Lane Position
 - Percentage of Trials with 1 or more lane exceeds
 - ≡ Longitudinal Control
 - Speed Difference (Max – Min speed during task)
 - ≡ Situational Awareness
 - Pedestrian Detection Task Response Time

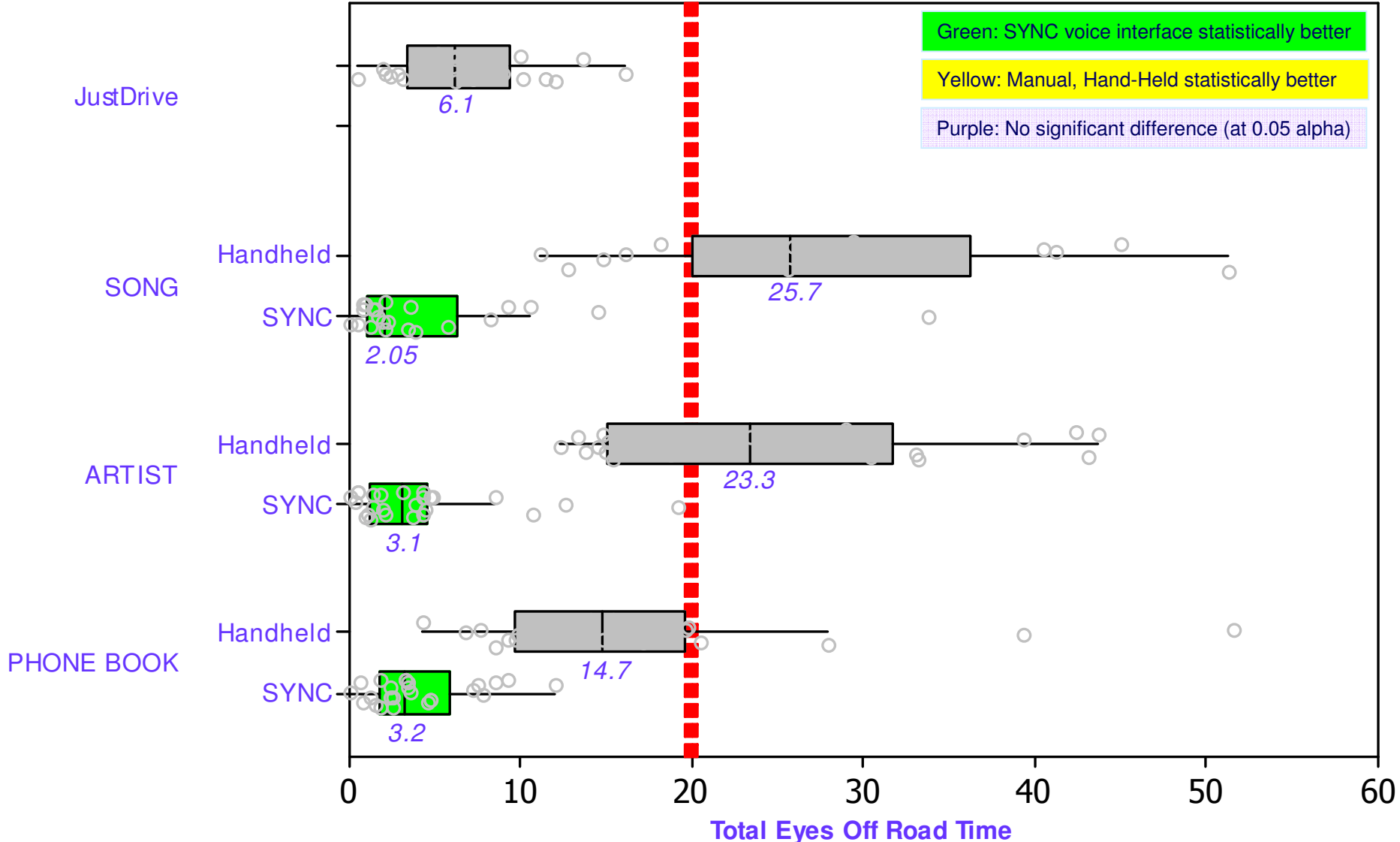
Methodology: Experimental Design

- Repeated measurements design comparing 7 tasks done with SYNC vs. with participant's hand-held nomadic devices:
 - ≡ **Song**: Select a specific song from the MP3 player
 - ≡ **Artist**: Select a specific artist from the MP3 player
 - ≡ **Phone Book**: Select a specific name from a contact list
 - ≡ **Digit Dial**: Dial a 10 digit number
 - ≡ **Incoming Call**: Receive an incoming call
 - ≡ **Text Review**: Retrieve a new text message (Listen to text-to-speech output in SYNC)
 - ≡ **Text Send**: Send a response text message (Select a canned message in SYNC)

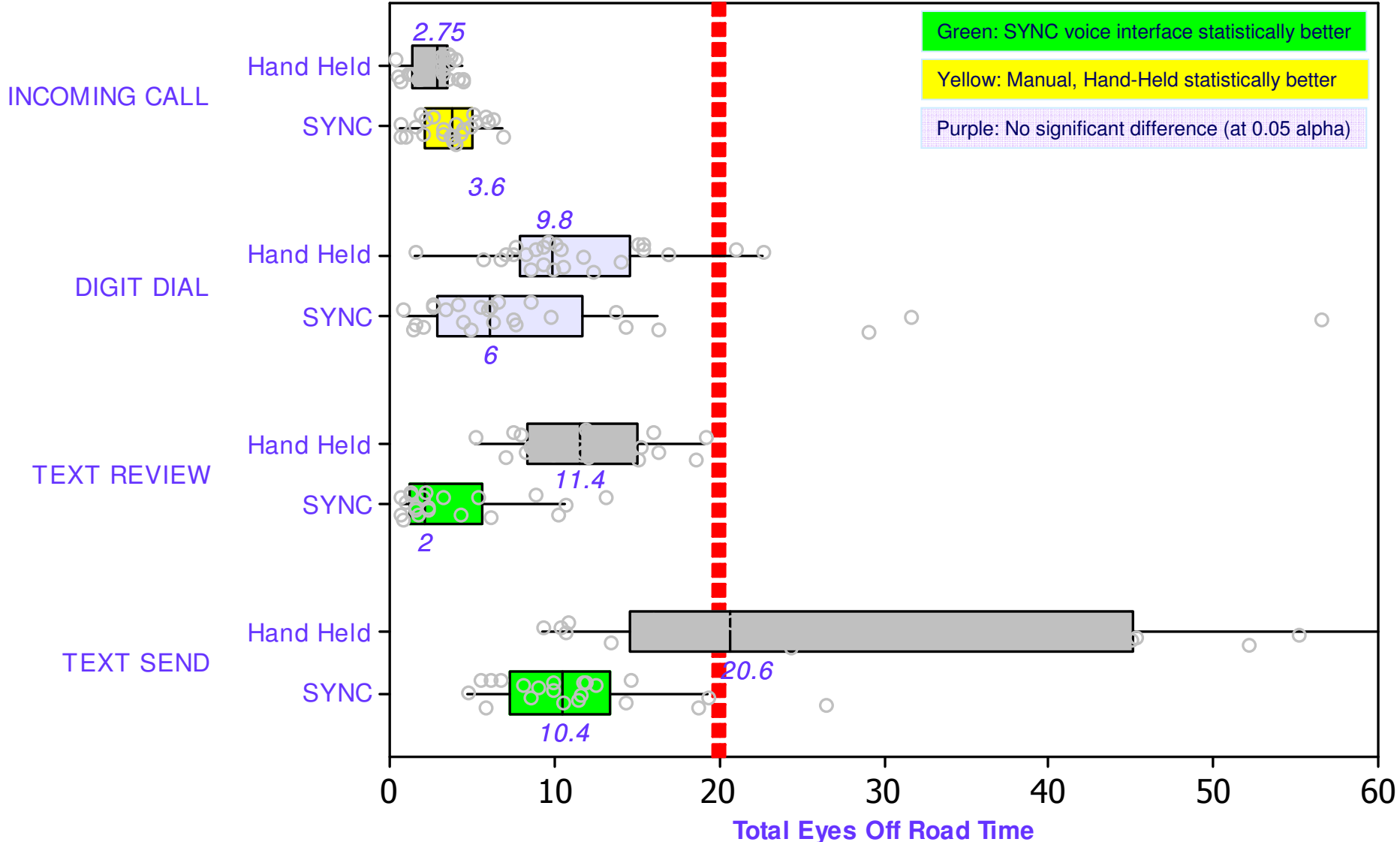
Results & Conclusions



Eyes Off Road Boxplot/ Jittered Dotplots & Medians



Eyes Off Road Boxplot/ Jittered Dotplots & Medians



Summary of Task Effects: Hand-Held vs. Hands-Free (SYNC)

TASK	Total Task Time	Total Eyes-Off-Road Time	Standard Deviation of Lane Position	Percent of Trials with a Lane Exceedance	Maximum Speed Difference	Pedestrian Detection Task Response Time
Song	V	V	V	V	V	
Artist	V	V	V	V	V	V
Phone Book	V	V	V	V	V	
Incoming Call	V	M				
Digit Dial	M		V			V
Text Review		V	V			V
Text Send	V	V	V	V		

Green: SYNC voice interface statistically better

Yellow: Manual, Hand-Held statistically better

White: No significant difference (at 0.05 alpha)



Conclusions

- **Relative to carried-in devices, SYNC, in most cases, allows you to keep your eyes on the road, your hands on the wheel**
 - ≡ **Eyes on the road**
 - Reduced eyes-off-road time
 - Shorter pedestrian detection response time
 - ≡ **Hands on the wheel**
 - Better lanekeeping
 - Less speed variability
- **No difference for some tasks, hand-held slightly better for incoming call ...when phone is readily accessible**
 - ≡ No difference implies no disadvantage for SYNC
- **SYNC advantages evident even with longer task times**
 - ≡ Digit Dial took longer, however, lanekeeping and object detection was better with SYNC
 - ≡ Task time effects are different for voice tasks

Final Remarks

- **Cell phone and other telematic device usage is increasing**
- **Ford supports effective efforts to reduce driver distraction**
- **Ford's approach is to provide drivers with safer ways to use these devices – SYNC**
- **Consistent with prior research and emerging naturalistic data on real world risks, the current Ford study demonstrates SYNC's effectiveness**

End of Slides

