Driver Distraction Research on the National Advanced Driving Simulator (NADS)

Elizabeth N. Mazzae
National Highway Traffic Safety Administration

NHTSA
Vehicle Research and Test Center
East Liberty, Ohio

May 12, 2003

SAE®

NHTSA
People Saving People
www.nhtsa.dot.gov

Research Team

- NHTSA HQ
  - Mike Goodman
- NHTSA Vehicle Research & Test Center (VRTC)
  - NHTSA: Liz Mazzae
  - TRC: Tom Ranney
- NADS Staff (University of Iowa)
  - Yiannis Papelis, Ginger Watson, NADS staff

NADS Driver Distraction Research Program

- NHTSA has ongoing studies addressing driver distraction issues
- Unique capabilities of NADS will be used to address questions that cannot be addressed in on-road experimentation

NADS Driver Distraction Research Program

- Projects
  - Wireless phones
  - In-vehicle information systems & electronics
  - Cognitive distraction

Research Objectives

- Wireless phone research is currently underway
- 3 wireless phone distraction studies:
  - 1: Examine effects of wireless phone interface on driving performance
  - 2: Effects of conversation characteristics on driving performance
  - 3: Assess drivers' willingness to engage in wireless calls under a variety of driving conditions

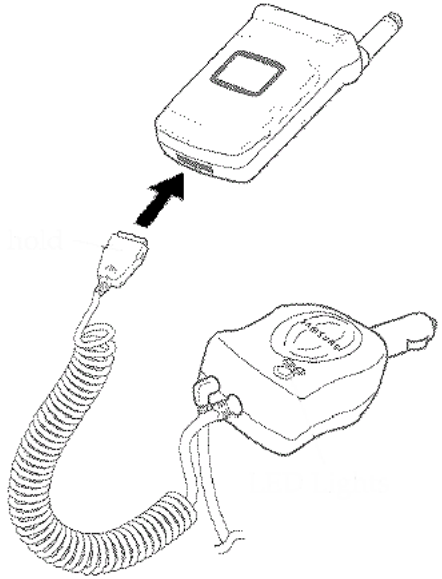
NADS Wireless Phone Study 1

- Focus: Phone interface type effects
- Evaluate the assumption that hands-free activity is safer than hand-held activity
  - Examine dialing, talking, answering
- Simulate voice communication in a variety of common driving situations with varying task demand

NADS Wireless Phone Study 1

Hand-held (HH)
- manual dialing & answering, HH talking

Headset Hands-free
-manual dialing & answering, hands-free talking with headset



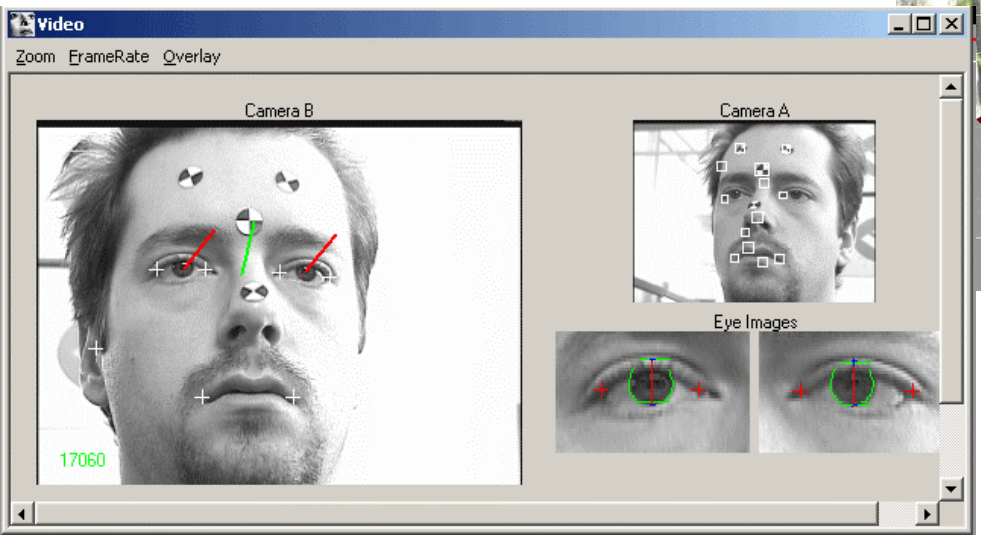
Voice Dialing Speaker Hands-free
-Voice digit dialing, manual answering, hands-free talking with speaker

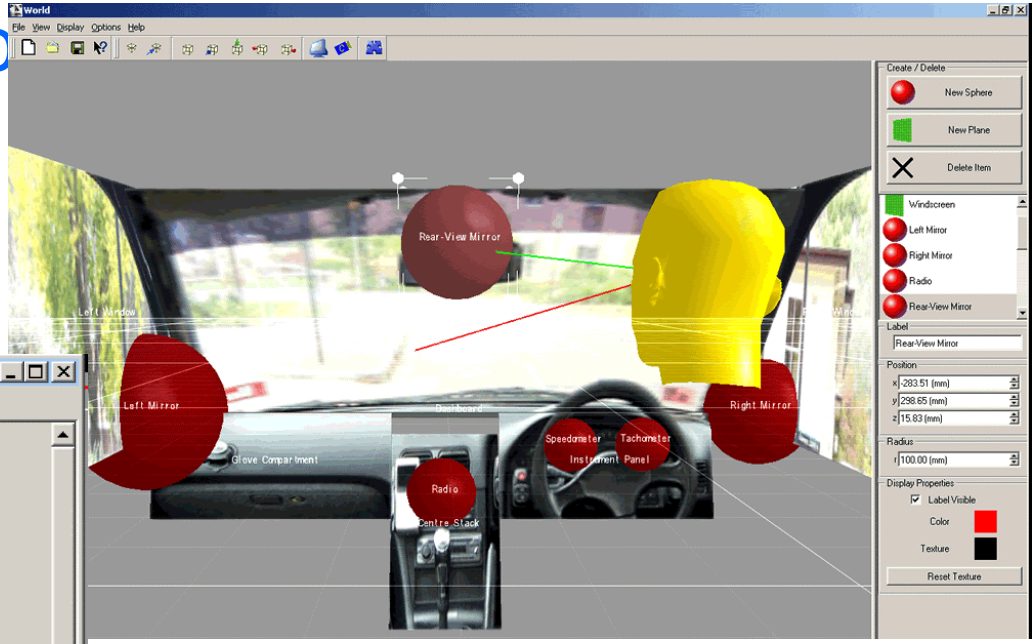
NADS Wireless Phone Study 1

- Experimental Design
  - Independent variables:
    - Phone interface: Hands-held, headset, HF speaker with voice digit dialing
    - Age: 18-25, 30-45, 50-60
  - 54 subjects

NADS Wireless Phone Study 1

- Dependent measures:
  - Vehicle-based: Speed, accelerations
  - Driver inputs: steering, braking
  - Task-based: Respo
  - Glance behavior



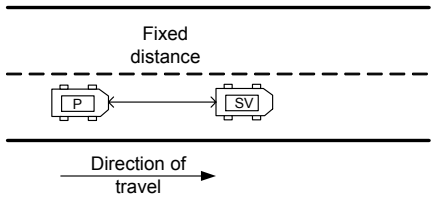
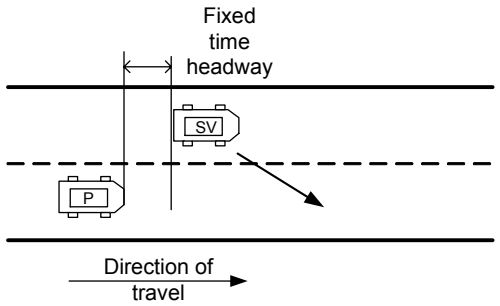
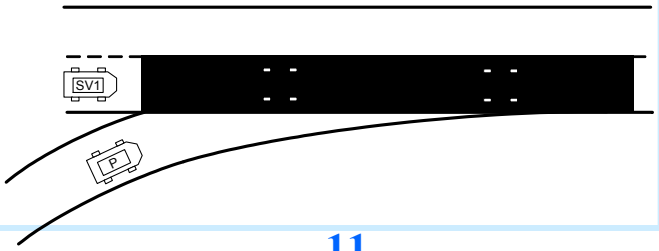


NADS Wireless Phone Study 1

- Procedure:
  - Subjects drive route containing traffic & events
  - Conversations to consist of verbal task performance (Baddeley task)
  - Monetary incentives establish priorities with respect to primary and secondary tasks
  - Call receipt/placement is prompted
  - Two road types: freeway and arterial
    - Separate data collections
    - No road type comparisons

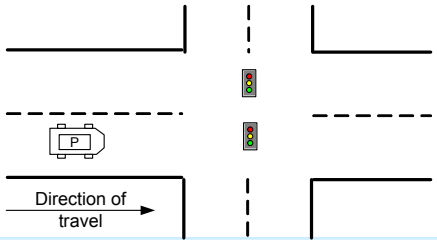
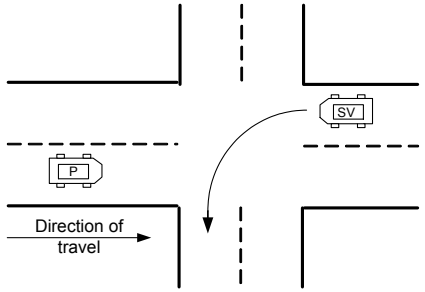
NADS Wireless Phone Study 1

- Freeway driving task events:

Event	Illustration	Dep. Measures
Car following		Speed, coherence, glance behavior, lane position, steering
Responding to lead vehicle cut-in or brake		Brake reaction time, minimum TTC
Merging		TTC, speed, success of maneuver

NADS Wireless Phone Study 1

- Arterial driving task events:

Event	Illustration	Dep. Measures
Responding to traffic signals		Reaction time, correct stop/go decision
Responding to cars turning in front		Reaction time, crash avoidance
Identification of specified visual targets		Reaction time, % correct detected, glance behavior

NADS Wireless Phone Study 1

- Examine driver behavior, performance, and responses to events by:
  - Dialing method
  - Conversation method (hand-held, headset, speaker)
  - Cross comparisons
  - Baseline vs answering, dialing, and conversing

NADS Wireless Phone Study 1

- Sample Hypotheses:
  - Hand-held conversation will:
    - …degrade driving performance more than hands-free conversation.
    - …divert more attentional resources away from driving than hands-free conversation.
  - Manual dialing will:
    - …degrade driving performance more than hands-free dialing.
    - …divert more attentional resources away from driving than hands-free dialing.

NADS Wireless Phone Study 1

- Sample Hypotheses:
  - Drivers in the "Younger" or "Older" age group will exhibit worse driving performance during wireless phone task components than will drivers in the "Middle" age range
  - In the "Voice Digit Dialing Hands-Free" condition, drivers will glance away from the forward roadway more than they will in the hand-held or headset hands-free conditions

NADS Wireless Phone Study 1

- Freeway pilot study has been completed
- Freeway main experiment underway
- Arterial pilot and main experiments to occur in Summer 2003

NADS Wireless Phone Study 2

- Focus: Conversation content
- Examine whether dimensions of conversation affects distraction potential while driving
- Simulate voice communication in a variety of common driving situations with varying task demand
- Both freeway and arterial road types

NADS Wireless Phone Study 2

- Experimental Design
  - Independent Variables:
    - Conversation content
    - Emotional intensity
    - Conversation duration
    - Wireless phone experience
    - Age
  - 54 subjects
- 1 wireless phone interface
- Call receipt/placement is prompted
- Monetary incentives establish priorities with respect to primary and secondary tasks

NADS Wireless Phone Study 2

- Sample Hypotheses:
  - Driver distraction will…
    - increase as drivers become engaged in conversations of high complexity
    - increase with increasing conversation intensity
    - increase with increasing conversation length

NADS Wireless Phone Study 2

- Project is in initial stages of development
- Testing to begin in late 2003

NADS Wireless Phone Study 3

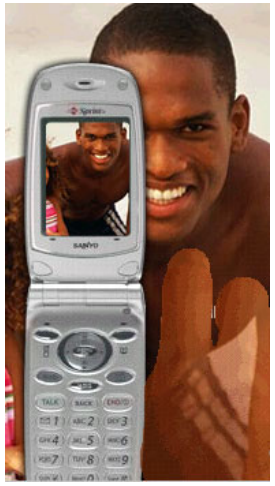
- Focus (preliminary): Drivers' willingness to engage in wireless phone calls while driving as a function of situation
- Assess drivers' willingness to make/receive calls under a variety of traffic conditions and situations

NADS Wireless Phone Study 3

- Factors may include traffic density, environmental conditions, conversation type
- Drivers choose when to make calls
  - Create situations in which driver needs to acquire info by phone in order to continue
- Determine whether hands free affects decision making with respect traffic situations in which drivers are willing to make calls
- Monetary incentives will be used to establish priorities with respect to primary and secondary tasks

NADS Assessment of Driver Distraction Due to In-Vehicle Information Systems (Telematics)

- Focus: In-vehicle electronic devices
- New devices have expanded functionality
  - Video phone calls, instant messaging, message retrieval, internet, traveler info, …



NADS Assessment of Driver Distraction Due to In-Vehicle Information Systems (Telematics)

- Examine the effects of the use of devices for functions other than those used for voice communication on:
  - Driving behavior & performance
  - Driver eye glance behavior

Development of Assessment Techniques for Evaluating Cognitive Driver Distraction

- Many crashes occur when the driver appears to be attending to the driving task, but does not recognize a traffic conflict
  - Typically characterized in crash record as "looked but did not see"
    - Looked but did not see crashes can also involve device use, visual detection errors, …
- Cognitive distraction examples include drivers being involved in intense phone conversation or lost in thought

Development of Assessment Techniques for Evaluating Cognitive Driver Distraction

- These situations will be investigated by developing ways of measuring cognitive distraction
  - Identify characteristics of drivers' behavior and performance that indicate the presence of cognitive distraction
    - E.g., eye glance patterns indicating a narrower field of view or a less active visual scanning pattern

Summary of NADS Driver Distraction Research Program

- NHTSA has ongoing studies addressing issues relating to driver distraction
- Current research focus is on distraction caused by wireless phone use
- Subsequent research to examine distraction due to other devices, measurement techniques for cognitive distraction
- Through this research we hope to better understand driver distraction, factors which affect it, and possible ways to reduce distraction

The End

Status of these and other NADS research projects run by VRTC can be found at:

http://www-nrd.nhtsa.dot.gov/vrtc/ca/nads.htm

Thank you for your attention!