



Understanding the distracted brain

Deborah Trombley
Transportation Initiatives
National Safety Council

<http://thebrain.nsc.org>



Distracted Driving

Reported to be involved
in 5,474 fatalities &
448,000 injuries
in 2009

16% of fatal crashes &
20% of injury crashes

- NHTSA Traffic Safety Facts



Distracted Driving



Distracted Driving

- | | |
|---------------|------------------|
| 1. Visual | Eyes off road |
| 2. Mechanical | Hands off wheel |
| 3. Cognitive | Mind off driving |





Distracted Driving

Understanding the
distracted brain –
cognitive distraction
and conversation

Uncovering what
we can't see
and may not be
aware of





Distracted Driving

- Leading factor in fatal and serious injury crashes
- 9% of drivers talking on handheld phones at any moment
- .6% of drivers manually manipulating phones

- NHTSA Traffic Safety Facts

- 1 million crashes involving talking on cell phones
- 200,000 crashes involving texting

- National Safety Council

- Cell phone users 4x as likely to crash, handheld and hands-free

- IIHS, Redelmeir & Tibshirani



Most People Talk While Driving

- 81% of drivers admit to talking on cell phones while driving:
 - 74% of Boomers
 - 88% of Gen X
 - 89% of Gen Y
 - 62% of Teen Drivers



- *Nationwide Insurance*



One Consequence: Fatal Crashes

Faces of Distracted Driving

<http://distraction.gov>

FocusDriven – The 5500

<http://focusdriven.org>



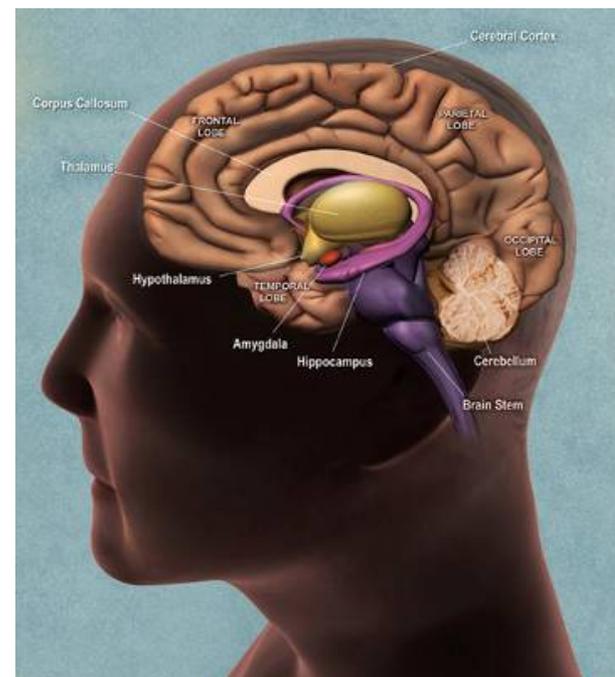
The Challenge

- Drivers don't realize that talking on a cell phone can distract the brain and take focus away from the primary task of driving
- Hands-free seen as solution, believed to be safer than handheld
- People recognize the risks of texting, eyes off road and hands off wheel more than risks of conversation



Cognitive Distraction

- Myth of multitasking
- Filtering information & impact on driver awareness
- Inattention blindness
- Cognitively-demanding vs. automatic tasks
- Risks to driver performance
- Passengers
- Pedestrians
- Prevention



National Institutes of Health



Multitasking: A Brain Drain

- Multitasking
 - Valued in our culture
 - Productivity
 - Skill on resumes
 - Technologies assist it
 - Technologies feed it

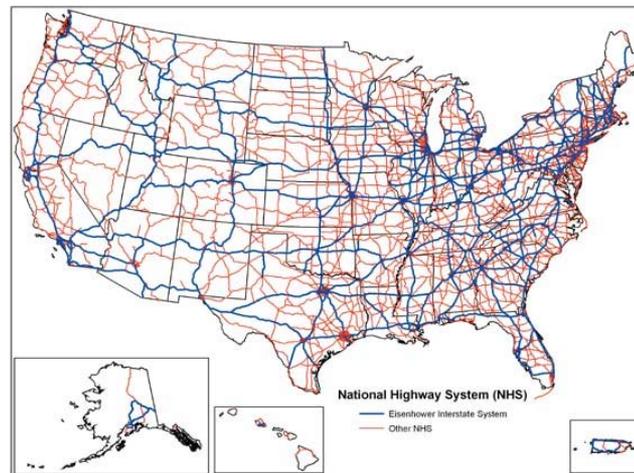


Multitasking: A Brain Drain

- But the brain doesn't multitask -- it is a myth
- The brain does not perform two tasks at same time, rather it:
 - Handles tasks sequentially
 - Switches rapidly between one task and another
 - Across/between regions of the brain

Multitasking: A Brain Drain

- Thousands of miles of interconnected nerve cells
- Pathways of neurons transmitting signals between brain regions
- Communications between brain regions





Multitasking: Hidden Costs

- Inefficiency
- More time
- Errors
- Reorienting to new task
- Switching costs
 - Fractions of seconds but can add up
 - Vehicle traveling 40 mph goes 120' before stopping, or 8 car lengths
 - No margin for error

“If I have ever made any valuable discoveries, it has been owing more to patient attention, than to any other talent.”

- Isaac Newton

English mathematician & physicist (1642 - 1727)



Multitasking: Impact of Hidden Costs

- Doing laundry while talking on phone
- vs.
- Driving while talking on phone
 - Risk
 - Potential severe consequences
 - Fractions of seconds make a difference

Process & Act on Information

- Brain engages in a constant process to:
 1. **Select** information brain will attend to
 2. **Process** information
 3. **Encode** to create memory
 4. **Store** information
- Different areas of brain & neural pathways are engaged
- Brain must communicate across pathways

Process & Act on Information

- Brain goes through two more cognitive functions before it can act on saved information:
 5. **Retrieve**
 6. **Execute** or act on information
- When brain is overloaded these steps are affected
- But people may not be aware

Encoding

- Info we see, hear, feel, taste, etc. must reach short-term memory to act
- Before reaching short-term memory: Encoding
 - Brain prioritizes, selects what to pay attention to
- Negatively affected by distractions and divided attention
- Brain screens out info to deal with distraction
- These decisions are not in our control, we're unaware
- Could be critical roadway information
- Hazard recognition, navigation, warnings

Encoding

- Drivers not aware of information filtered out

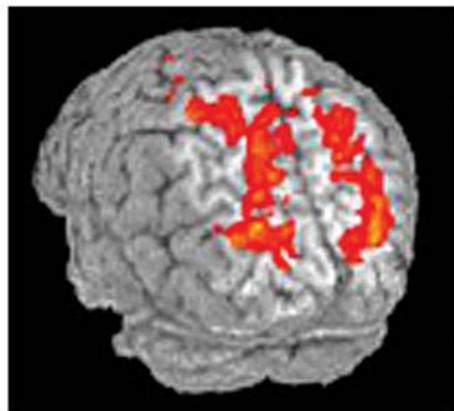


*Inattention blindness and encoding.
Source: National Safety Council*

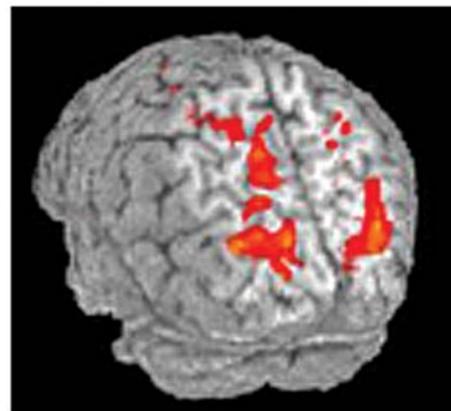
Bottleneck

- Regions of brain pull from shared limited resource
- Tasks can be seemingly unrelated – conversation and vision
- Interrelated and with risk when behind the wheel
- Cognitive tasks can compete for brain's information processing resources

Driving only



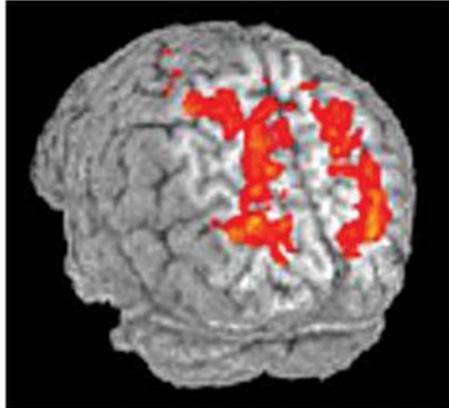
Driving with sentence listening



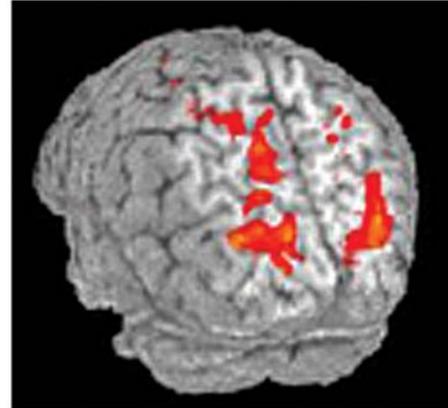
Functional magnetic resonance imaging images

Source: Carnegie Mellon University

Driving only



Driving with sentence listening



Functional magnetic resonance imaging images

Source: Carnegie Mellon University

- Listening to sentences on cell phones decreased activity by 37% in the brain's parietal lobe
- Important for visual movement through space, integrating sensory information, language processing
- Decreased activity in brain's occipital lobe which processes visual information
- Listening and language comprehension drew cognitive resources from driving

What We May Not See

- We believe we see and are aware of everything in our surroundings
- But our brains actually fully analyze very little information
- Limited visual awareness
- We're blind to many changes around us unless we pay close, conscious attention to specific details

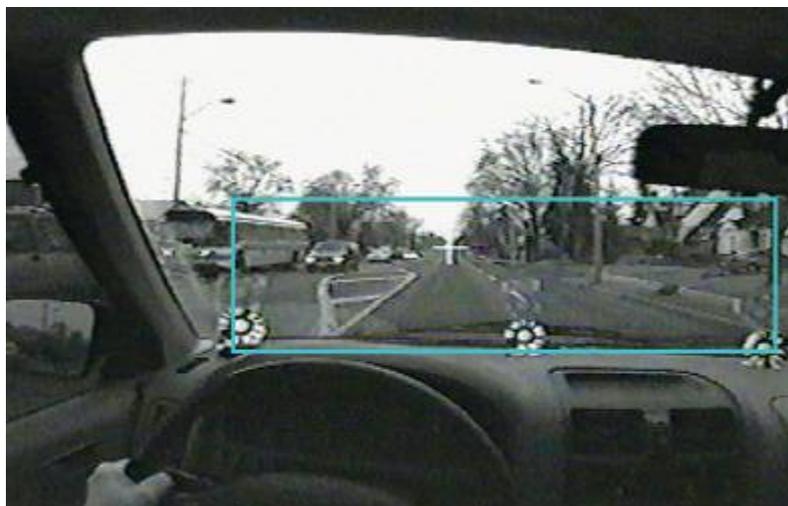




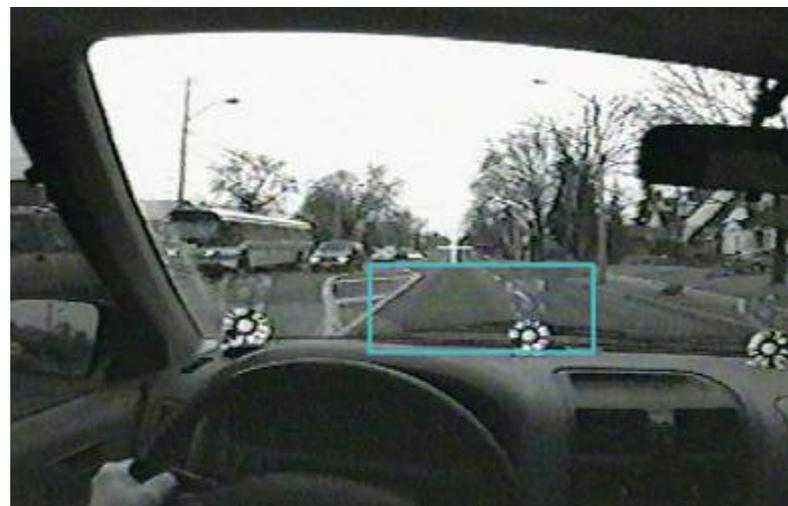
Inattention Blindness

- “Looking” but not “seeing”
- Drivers talking on cell phones less likely to see:
 - High and low relevant objects
 - Visual cues
 - Exits, red lights and stop signs
 - Navigational signage
 - Content of objects

Inattention Blindness



Where drivers not using a hands-free cell phone looked



Where drivers using a hands-free cell phone looked

Source: Transport Canada



Automatic Tasks

- Most driving conditions: well-practiced automatic
 - Slow down at yellow/red lights
 - Activate turn signals
 - Lane-keeping
 - Noting speed limit, navigation signs
 - Check mirrors



False Sense of Security

- Nothing bad happens during most trips
- Drivers may believe they can safely multitask
- Response to sudden hazards can be impaired
- Cannot feel and see limits to brain as we can with physical limits



Cell Phone Conversation: Driver Risks

- Looking but not seeing
- Problems staying in lane
 - More automatic, but small margin for error
- Response time = reaction time and movement time
 - More cognitively demanding
 - Watch for unexpected events, decide response, act
 - Reaction time – attentional resources and information processing
 - Movement time – muscle activation
 - Numerous studies show cell phone conversation affects reaction time



Passenger Conversations

- Adult passengers share awareness of driving situation, a safety benefit
 - Co-pilot
 - Can adjust conversation
 - Adults with passengers have lower crash rates
- Cell phone talking has different social expectations
 - Silence is weird
- Even passenger conversation can be distracting





Q: See anything unusual?

~60% walking with friend

~33% walking alone or w/music

8% talking on cell phone

Q: Did you see the unicycling clown?

71% with friend

51-61% walking alone or w/music

25% talking on cell phone

Environmental awareness

Pedestrians

- Walking is cognitively demanding
- Chewing gum is not
- Talking on cell phones, more likely to walk unsafely:
 - Look for traffic before stepping into street
 - Look at traffic while crossing street
 - Notice unusual objects placed along path

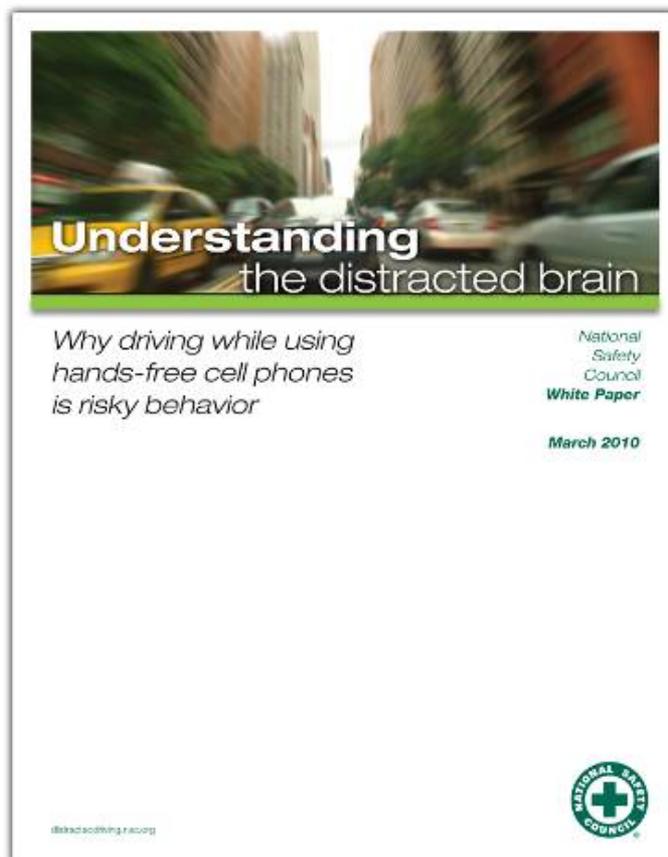


Prevention

- Widespread education
- Corporate cell phone bans
- Legislation
- Enforcement of laws and policies
- Technology



White Paper



<http://thebrain.nsc.org>